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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

REVIVAL OF THE WINDMILL.

If the views of one of our foreign correspondents are to be accepted, the windmill—that old and classic source of power which was the main dependence of our forefathers before the invention of the steam engine—is again to be put to work, in Germany, furnishing the power to drive dynamos. Of late years windmills have been used principally as subjects for the landscape painter. We have not in mind here that hideous but effective modern machine, but the old four-armed, picturesque structure familiar to all artists. They have served man faithfully for centuries, and were at last promoted to a well earned life of indolence. But now the rude hand of the engineer, which regards nothing as sacred that can be made to serve a useful purpose, presumes to degrade these venerable landmarks and set them to driving the unromantic dynamo.

THE MULTIPLE-UNIT SYSTEM IN THE UNITED STATES AND EUROPE.

A recent summary of the railway companies throughout the world which have either installed or contracted for installations of the multiple-unit system of electric traction shows how widely the advantages of this system are being recognized. There are in the United States twenty-one companies using this system. This number includes the following important railways. The Interborough Rapid Transit Company, controlling all the underground lines and the Manhattan Elevated Railway, of New York city; the Boston Elevated Railway; the South Side Elevated Railway, of Chicago; the Brooklyn Elevated Railway, and the Aurora, Elgin & Chicago Railway. In the United Kingdom the electrical equipments of the following railways will be operated on the multiple-unit system: The Central London Railway, the Great Northern & City Railway, the Northeastern Railway, the Mersey Railway and the Metropolitan District Railway. On the continent of Europe the Union Electricitats Gesellschaft, in Berlin; the Western Railway, of France; the Orleans Railway; the Gallarate division of the Mediterranean Railway Company, and the Athens-Piree Railway, in Greece, have also adopted this system.

Advantages of the Multiple-Unit System.

This list shows how thoroughly the advantages of the multiple-unit system have been recognized. All of these thirty-one railways will use one or the other of two American systems. It was only natural that the advantages offered by electricity and which are made available by the multiple-unit system, should be recognized first in this country where the trolley system had such a remarkable development. These advantages are the safe and economical operation of short or long trains as the traffic on the line may demand and by distributing the motors throughout the train, the weight of several cars instead of one is made available for quick acceleration, an essential for high average speeds when stops are frequent.

All Systems Are American.

Of the three systems which will be used on these roads, two are entirely electric and the other an electropneumatic system. In the first two the controllers of all the motor cars are operated by means of an electric circuit under the control of the engineer. In the other, the controllers of the various motor cars are operated by compressed air. One system has been used for a number of years and has shown its reliability. While the electropneumatic is newer, there is no reason to doubt that it will prove satisfactory as compressed air has been used in railway service for many years and is well understood by the company which will employ it. We can take some satisfaction from the fact that these systems to which engineers are now looking for the handling of heavy passenger traffic have both been developed in this country, and two carry the names of distinguished American engineers.

RADIUM.

Not very long since we were told that a careful estimate had been made of the possible physical experiments. The results showed that the greater part of the research work had already been performed, and it only remained for physicists to clear up the litter that had been left behind, in order to complete the science. By what process this authority had reached his conclusions we are not aware; but there can be no doubt that to many it seems as if the field of physical research was more or less exhausted.

New Fields for Research.

The events of recent years have shown how far at fault this would-be prophet

was. Discoveries have been made which open up vast fields for the experimentalist. How vast they are no one can say to-day. The work of J. J. Thomson and others, in the study of atomic physics, indicates that it will be many years before that one line of work can be considered well covered. The discovery of the so-called radio-active bodies by Becquerel, Curie and others points to a new line of investigation, and shows, in a way, how little we really know about matter and energy, the two fundamental conceptions upon which all physical laws are based.

Study of Vacuum Tubes.

The action of electrical discharges in vacuum caused phenomena which were studied for many years, without many results. Then came the startling announcement of Rœntgen, that rays were thrown off from these tubes which not only affected photographic plates, but were able to penetrate bodies which are opaque to ordinary light.

Radio-Active Substances.

Rœntgen's discovery led many into that field of physics. The effect of these rays in producing fluorescence and phosphorescence of certain substances induced some to begin active study of these two well-known phenomena. In studying these, their effects upon photographic plates are carefully investigated. It was found in some cases that emanations of phosphorescent bodies would not only act upon the sensitive plate, but would act through opaque bodies as did Rœntgen rays. Some suggested that this action might be due to vapors given off, which diffused through the separating body, but this was shown not to be the case. Working along these lines, Becquerel found that uranium, which was one of the most active of the phosphorescent bodies employed, could act upon the photographic plate without previous exposure to light, and, therefore, without becoming phosphorescent. The action seemed to be brought about by some inherent property of the material itself. Another property these salts possessed was the ability to discharge electrified bodies.

New Radio-Active Materials Discovered.

While studying the radiations of uranium, the Curies found a specimen which seemed to be more active than the amount of uranium contained within it seemed to warrant. It occurred to them that these radiations might be due to some other material which appeared as an impurity in the uranium, and that this specimen contained that material somewhat in excess. Careful chemical work enabled them to concentrate the active element, producing a material which was far more active in these radiations than any which had previously been produced. This was called polonium, after Poland, the native land of Madame Curie. By further investigations the Curies were able to separate a second substance, differing from the other in having the characteristics of barium, and this they called radium.

Nature of the Radio-Active.

The question which is now confronting the physicists is to decide upon the nature of these radiations. Are they rays thrown off, similar to light, or are they minute particles of matter resembling Thomson's corpuscles? The most careful weighings have as yet shown no loss of weight; but assuming the particles thrown off to be of the nature of corpuscles, it has been shown that the loss in weight in many years would be far too small for detection with any means at present at our disposal. Another remarkable property of radium has recently been noticed by the Curies—that is, its power to maintain itself at a temperature higher than its surroundings. It was found that specimens of radium, when carefully protected from all external sources of heat, maintained indefinitely a temperature 1.5 degrees centigrade above its surroundings. This, of course, means that there is a continuous radiation of heat, as well as of Becquerel rays, and this outpour of heat is difficult to account for by an internal or molecular change. This action has led the Curies to suggest tentatively that an external source of energy, of which we at present have no knowledge, might cause this phenomenon.

Wider Fields of Research Probable.

The results of further work on the subject will be watched for with interest, as it promises to make a great advance in our knowledge of molecular physics, and may open up a new line of work from this one, which itself has as yet been slightly covered.

ENGINEERING DATA.

Last fall the board of directors of the American Institute of Electrical Engineers authorized the appointment of a committee to collect engineering data. The officers of the Institute have given careful consideration to methods of conducting this work, and after formulating plans, a committee has been appointed. It is not intended that this committee shall publish information on well-known subjects, but their efforts are to be directed toward obtaining data on new and special subjects. Much data can be made valuable in this way, though at present it never reaches the public. This committee will also be the means of collecting and transmitting promptly to the members of the Institute, the results of the most recent practice in the art.

Cooperation Desired.

The committee is anxious to receive curves, short methods of computation, empirical formulæ and special data on subjects which are of value, but do not seem to warrant an Institute paper. They will also endeavor to secure the cooperation of electrical manufacturing companies which have possession of much information which could be made public without detriment to their interests.

We heartily urge all engineers and manufacturers to cooperate with this committee as far as possible. All of us are greatly indebted to those who have gone before, and it is only right that we should assist as far as possible in giving others the benefit of our own experience and in aiding those who must take up the work where we leave it. The success of this committee will depend largely upon the generous help of all who are engaged in the study or practice of electrical engineering.

NO MUNICIPAL LIGHTING IN NEW YORK.

The New York Legislature has very properly killed, by a decisive vote, the bill providing for a municipal lighting plant for the city of New York. Municipal ownership of lighting plants is not advantageous either to the public or to the city.

MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

The third general meeting of the American Electrochemical Society, which was held in New York city last week, was most successful. The attendance was good, two hundred and fifty members and guests being registered. The local committee had spared no efforts to ensure visiting members a hearty welcome and a pleasant as well as profitable convention. The Chemists' Club had courteously offered their club house as headquarters, and this not only gave an excellent hall for holding the meeting, but brought the members together under pleasant auspices. The kindness of the German Liederkranz in offering their club house as a banquet hall for the reception and banquet added much to the social side of the convention and helped very materially in making this part of the convention a success.

Interesting Papers Presented.

At the formal meetings for the discussion of papers, a number of interesting contributions were made, and many points of practical value were brought out in the discussions. From the number of papers contributed at these meetings, it seems evident that the organization of the society was not made any too soon. It is, however, rather unfortunate that the committee on papers was not able to pass upon and put into print all the papers which were read. While this is always difficult to do, it would seem to be a wise move on the part of the society if it should insist upon having all contributions in print before they are presented. So many papers are scheduled for every session of the meeting, that time does not always allow of as full and free a discussion as would take place were the members familiar with their contents.

Valuable Paper on Vapor Density Determinations.

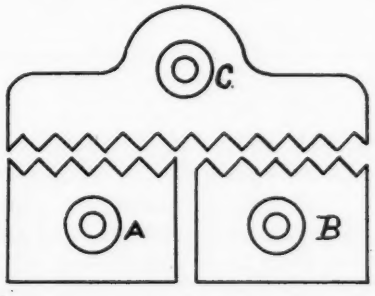
A paper by Dr. Walther Nernst on the "Determination of Vapor Density in the Electric Furnace" was read at one of the meetings and was a notable contribution to scientific literature. The study of gases and materials at high temperatures is extremely important from the practical as well as theoretical side, in connection with the use of the electric furnace, and although the work described by Dr. Nernst is only a beginning of his researches, the experiments are being carried on, and further and much valuable data will no doubt be obtained. It is noteworthy that although the conditions under which these experiments had to be carried out were troublesome and the quantities worked with were small, very satisfactory results were obtained. Some of the papers contained valuable practical hints and it is to be hoped that the active workers in electrochemistry will be induced to take a more active part at future meetings.

THE DESIGNING OF TELEPHONE APPARATUS—XX.

BY W. A. TAYLOR.

After having installed the apparatus, about the first thing which has to be contended with is the burning out of the various coils of the telephones and switchboard apparatus by various electrical currents foreign to the telephone circuits. There are three kinds of currents which are thus troublesome: First is the lightning; second, high-voltage electric currents from power and lighting circuits, and, third, low-voltage power and lighting currents.

The lightning, no doubt, causes the greatest amount of trouble to the telephone system, especially in the case of farmers' and toll lines. There being more length of line in the circuit there is a greater chance of being a large difference of potential between the two ends. It is not necessary that the lightning shall actually strike the wire in order to inflict damage. A heavy charge of lightning striking several miles away is often the cause of burning out several coils, or a flash across the heavens will cause like trouble. Any flash of lightning causes a high or low-potential in the earth's charge in the immediate vicinity and the current will flow away from or toward that point in order to equalize the earth's charge. The quantity in these cases is nearly always very small, but the potential is apt to be quite high, making it possible to jump any distance up to perhaps half an inch in many cases. As the impedance of the magnet coils is very high to such a rapidly oscillating current, it will prefer to jump quite a distance rather than go through all the turns of the winding. It is here that the damage



is done. A spark will jump from the winding of the magnet to the core and either open the winding or ground it or do both. It is seldom that more than a few turns are injured, and this injury nearly always necessitates the entire rewinding, as the damage is next to the core. The fact that lightning prefers to jump rather than to pass through the winding of the magnet has led to the making of the air-gap arrester. The old form of arrester is what is known as the saw-tooth arrester. A diagram of this arrester is shown in Fig. 55. This consists of three thin brass plates with the saw-teeth as shown. Plates A and B carry the two line binding-posts, while plate C carries the binding-post which connects with the ground. The teeth on the ground plate are very close to those of the line plates; in fact, they are so close that a short-circuit is barely avoided. This form of arrester saved many an instrument, but the lightning very frequently preferred to destroy the coil. The idea of the saw-teeth was to make an easy discharge path, as any high-potential charge is discharged more readily from a point than from a smooth surface.

The poor work of this form led to the invention of the carbon block arrester, and this form has been almost universally adopted. In this form carbon blocks take the place of the metal plates and they are much closer together. The usual form consists of two blocks of carbon separated from each other by a piece of perforated mica or a silk ribbon. One block is connected with the line and the other with ground. The separation varies according to the ideas of those who make the arrester and also those who take care of it. No doubt, for protection's sake, the closer the better; but there is unfortunately a very great tendency for a discharge to short-circuit the

arrester when the blocks are too close and so they must be separated more than would be otherwise desirable. If the thickness of the separation piece is about three one-thousandths of an inch good service is still possible. The two surfaces which are presented toward each other should be roughened by means of sandpaper so that the smooth surfaces left by the mould are broken. Carbon thus treated has a large number of points on its surface, making a discharge easy. Beside the fact that there are a large number of discharge points on the surface, the resistance of the gap between the two blocks suddenly falls to a very low point as soon as an arc forms, and the path to ground is practically a short-circuit as long as the arc of discharge is continued. The vapor of the carbon in the arc is responsible for the low resistance. This arc between the blocks will raise a small cinder or burr, and if the air-gap is too small the arrester becomes permanently short-circuited. Even when the carbons are separated the proper distance there are frequent short-circuits which necessitate their removal and cleaning. This short-circuiting on toll lines and other long lines where there are a number of telephones becomes a serious item of expense, as when one instrument on the line is short-circuited all the rest become useless. As often happens, the party having charge of the instrument will neglect to fix up the carbons and so the trouble man is put to the expense of livery hire just to clean the carbons. In order to prevent such trouble as this, fuses are used between the line and the arresters, and frequently a switch is introduced to cut out the telephone during the storm. The fuse is usually very light and will blow easily, and when it opens there is no trouble from a short-circuit on that instrument. It must not be supposed that the fuse will do much to protect the telephone. The lightning would be all through doing harm before the fuse would blow; but having once blown, there will be little trouble from any short-circuit on the line. When the subscriber then wishes to use his telephone he can do so as soon as he replaces the fuse or perhaps cleans the carbons.

The second class of currents considered are those of high voltage; that is, above 250 volts. With such voltages at hand it is necessary to have both a fuse and a carbon block arrester at the instrument end of the line and at the switchboard end. The fuse should be of low enough capacity to blow with a current which would melt the fuse before the coils burn out. For voltages above 350 the carbon block arrester will act, and in such carbon block arresters it is usual to have a small drop of fusible metal placed in a cavity in the face of one of the blocks, which metal will melt when the block heats from the discharge and falling against the other block completely short-circuits it, stopping the arc and preventing a fire. To ensure the putting out of the destructive arc between the blocks, the fuse is put between the carbon arrester and the line, then when the current rises to a sufficient degree the fuse blows and stops all trouble. The fuse at the subscriber's substation should be placed outside, though the carbon blocks may be inside. Another fuse should be placed in circuit where the line enters a cable, and another inside of the office. The cable fuse may be heavier than that in the office so that it will blow last, saving the replacing of the fuse on the pole every time that in the office blows. A half-ampere fuse at the substation, one-ampere on the cable pole and half-ampere in the office is considered good usage generally, though authority exists for almost any combination up to six-ampere fuses. The high-current fuses should not be used unless heat coils or sneak arresters are used. This type will be explained later. All carbon block arresters should be mounted upon fireproof bases where the lines upon which they are mounted are in the vicinity of dangerous electric light and power wires. All fuses in the cable boxes should be so designed that the blowing of one or more will not affect any of the others or in any way set fire to the wires. This is a very essential point to look after, as a cable-pole fire is very expensive and, unfortunately, too frequent.

Third Annual Meeting of the American Electrochemical Society.

A Successful Meeting Held in New York City—Papers and Discussion.

THURSDAY MORNING SESSION.

MEMBERS and guests of the American Electrochemical Society assembled at the Chemists' Club house, 108 West Fifty-fifth street, New York city, on Thursday morning, April 16. After a meeting of the directors, the society was called to order by Dr. C. A. Doremus, chairman of the local committee, who welcomed visiting members on behalf of the local members and introduced President J. W. Richards, who took the chair. President Richards introduced Dr. Wm. McMurtrie, who extended to the society the hospitality of the Chemists' Club, New York city, and expressed the pleasure of the club in having this meeting held at their club house. He said that New York would doubtless be the centre of the chemical activity of the country and it was the desire of the Chemists' Club that their house be regarded as the headquarters of all chemical societies. Visiting chemists were welcome there at all times; it was to be hoped that this meeting was only a beginning of the cordial relations which would exist between the several chemical societies.

President Richards, on behalf of the society, thanked Dr. McMurtrie and the members of the Chemists' Club for their hospitality.

REPORTS OF OFFICERS.

Secretary Reed then reported upon the conditions of the society. There are at present 492 members, fifty-three of these being foreign. He recommended that a systematic effort be commenced to increase the membership and that the matter of local sections be considered. At the present rate of growth of the society some action in this direction would soon be necessary.

Treasurer P. G. Salom reported an excellent condition of finances. There was on hand, the fifteenth of this month, allowing for all expenses, $2,170.

President Richards reported that the board of directors had appointed a committee to report upon plans for cooperating with other societies.

PAPERS.

Dr. Wilder D. Bancroft then read his paper upon "Constant-Voltage and Constant-Current Separations." The whole process of electrolytic separation depends upon extracting one metal from the solution first; this would seem to indicate that constant-voltage methods would be

best. Such methods were suggested by theoretical conclusions and were used by Ostwald. However, all practical methods have been developed using constant currents. Since the solution must change as one metal is abstracted, hydrogen must therefore be given off. Tables were shown giving the order in which metals could be extracted from various solutions. These showed that hydrogen may be given off at two points in certain of these extractions, depending upon the condition of the solution. All but three of the separations effected were constant-current methods.

In the discussion of this paper, attention was called to the difference existing between the laboratory analytical method, where insoluble electrodes were used, and the commercial processes using soluble anodes.

In the absence of the author Dr. Bancroft then read the paper presented by Dr. H. T. Barnes upon the "Experimental Study of Some Electrode Effects." This paper recounted the study the author had made with platinum electrodes. There may be a difference of potential between two platinum electrodes, when introduced into the same solution, this effect being due to occluded gases. Boiling the solution in order to drive off all gas enabled platinum electrodes to be brought into comparable conditions. Addition of gas to the solution set up an electromotive force.

President J. W. Richards then read the paper prepared by himself and Mr. W. S. Landis, entitled the "Electrolysis of Water." One experiment was described in which a thermometer bulb containing two platinum wires as electrodes was filled completely with acidulated water. Upon sending the current through this cell the bulb exploded. The experiment was then repeated using a thick thermometer stem. The electrodes were sealed into the ends of this by Canada balsam. Applying 3.3 volts to this cell no measurable current passed, but upon breaking the seal the current at once passed. A description was then given of an experiment made to determine the electromotive force required for the decomposition of water. In this experiment the energy supplied to the cell was calculated, and heat developed in the cell was measured. The difference between these values was represented by the energy required to decompose water, and knowing the current flowing, the electromotive force was deducted. The value obtained was 1.49 volts. Experiments were then described in which voltages less than 1.5 were used to pass a current through acidulated water. In the discussion of this paper it was brought out that platinum is an unsatisfactory metal for this work, as it combines with oxygen or hydrogen, Mr. Carl Hering stating that he had found gold more satisfactory, though Mr. S. L. Bigelow had found gold to be a little better than platinum. Professor C. F. Burgess described an experiment which he had made using a strong steel cylinder filled with acidulated water. He found that a current would pass with a pressure less than one volt. The current, however, decreased rapidly, but upon shaking the cell it rose again to its first value, showing that polarization had been caused by a deposit of gas upon the electrodes.

Dr. Bancroft then read a second paper entitled "Experiments with Metallic Diaphragms." He explained the action of a current passing through a solution which contained a metallic diaphragm partially closing the cell. By changing the length of this diaphragm parallel to the direction of current flow, more or less of the total current could be caused to flow through it. If, however, a longer diaphragm using two metal plates connected externally by a heavy conductor is employed, the current flow becomes more or less complicated, as each plate may act both as cathode and anode. With a cell of this construction he was able to deposit copper, when a voltmeter indicated a difference of potential of only 0.7 volt.

THURSDAY AFTERNOON SESSION.

After lunch served at the club house, the afternoon session was begun with Mr. Reed's paper upon the "Protective Action of Zinc Chloride upon Metallic Iron." He had filled a test tube with zinc chloride, and placed within this some bright steel wire nails and the whole was set aside for two years, during which time there was no apparent corrosion of the iron.

Dr. Max von Recklinghausen then read a paper entitled "Insulating Materials as a Field for a Chemist." In this the author discussed briefly the properties of insulating materials at present used in the construction of electrical machinery, pointing out the desirable features for various purposes as well as the undesirable ones.

Dr. von Recklinghausen was followed by Mr. H. B. Coho, who gave an historical review of the storage battery. In the discussion of this paper Professor H. S. Carhart stated that in 1881 Planté had used pasted cells but did not obtain as good results as with his formed cells.

Mr. E. A. Sperry, in introducing his paper upon the use of "Pyroxyline in Electric Storage Batteries," stated that the cells which had been imported for the Boston plant in 1881, and which had been referred to by Mr. Coho, were still in excellent condition. He had seen some of these plates recently and they showed no deterioration, while the capacity had increased eighteen per cent. These cells were of the Tudor type and showed what might be expected of carefully manufactured plates.

Dr. W. H. Walker then presented his paper on the "Concentration Changes in the Electrolysis of Brine." He discussed the action going on in an electrolytic cell and offered an explanation for the phenomenon that in electrolysing brine, the products of decomposition are not as great as called for by Faraday's law.

Professor H. S. Carhart read a paper entitled "Concentration Cells Considered as Thermoelectric Cells," and explained the reactions going on when one of these cells was carried through a Carnot cycle.

Mr. A. A. Knudson presented a paper entitled "Corrosion of Metals by Electrolysis." This was taken up under two heads—galvanic action between dissimilar metals, and the destructive effects of railway currents upon subterranean metals. Under the first heading a number of instances were mentioned, and methods suggested to check the corrosion. The effect of railway currents was discussed, and views were shown of metals which had been buried and were badly corroded, presumably by such currents. The last part of the paper gave an account of an electrical survey of the eastern part of Manhattan, showing an apparent flow of current from the west end of Brooklyn Bridge, easterly to the Kent avenue power station of the Brooklyn Rapid Transit Company.

In the discussion of this paper attention was called to the necessity for not laying too much stress upon current measurements from voltage readings on buried conductors. It was suggested that the conductor through which the current to be measured was flowing be shunted with an ammeter, and in this way, by fall of potential measurements, the value of the current could be determined more accurately. It was also suggested to protect the bridge piers and pipes by attaching zinc blocks to the iron. Enclosing the pipes in cement was suggested as a protection against corrosion.

THE BANQUET.

Thursday evening the members and guests of the society assembled at the club house of the German Liederkranz, which had been placed at the disposal of the society, where a reception was held, followed by a very enjoyable banquet. A delightful musical programme had been arranged. The speakers were introduced by Toastmaster C. A. Doremus. President Richards responded to the toast, "America, the Electrochemical Centre of the World." Dr. Walther Nernst, of Göttingen, spoke on "The Development of Electrochemical Theories." Mr. Charles F. Scott, president of the American Institute of Electrical Engineers, discussed the aims of this institution and its relation to the American Electrochemical Society. Dr. Charles F. Chandler, of Columbia University, spoke of the organization of the American Chemical Society, and of the Chemists' Club, and Dr. H. W. Wiley, chief chemist of the Agricultural Department, responded to the toast, "Kitchen Chemistry."

FRIDAY MORNING SESSION.

Dr. N. S. Keith presented a note on "The Composition of Electroplating Solutions." The necessity of keeping the electrolyte in the proper condition was emphasized, and attention was called to the effect upon this of impurities in the anode. Local action also may cause trouble. Under ideal conditions there should be no corrosion of the electrodes, except during use. Agitation assists in removing the gases liberated. Heat also helps. Strong solutions allow of high current densities. Precautions necessary in the deposition of gold, silver and lead were discussed.

In the discussion Mr. H. E. Heath described his experience with a unipolar dynamo in electrolytic deposition. This machine was designed and built eight years ago, and has been in constant use since then. No repairs have been necessary, except renewing the brushes once, about two months ago. The armature is made of iron. The machine gives a steady current, and it was found that this allowed the use of a higher current density and considerable variation in the solution, without affecting the quality of the deposited metal.

Mr. C. O. Mailloux called attention to Dr. Keith's early work in electrometallurgy, and described his experience in developing and introducing improvements in electrotyping.

President Richards then read a paper written by Mr. Titus Ulke, entitled, "Modern Electrolytic Copper Refining." This paper called attention to the secrecy which is observed in electrolytic processes, and emphasized the advantages which would accrue to all workers in this line if they exchanged ideas and experiences freely.

Dr. Nernst then read a paper entitled "Determinations of Vapor Density in the Electric Furnace." Work has been carried out at 2,000 degrees centigrade. Porcelain vessels were first tried, but these were found not suitable. Iridium was then thought of, as it has a melting point of 500 degrees higher than that of platinum. The metal is, however, brittle at low temperatures. The well-known firm of Heraeus, instrument maker, after two years' work, recently constructed a Meyer's tube of pure iridium, with which the author has conducted a number of experiments. The making of this tube is very difficult, as the metal had to be forged at white heat. As the tube was small, but small quantities of material could be worked with, and it became necessary for the author to construct a delicate balance. This was done, using a quartz fibre. The tube was then placed within a cylindrical tube of the same material, having broad circular flanges attached to the ends. An alternating current was passed through this and brought it up to the desired temperature. To determine this comparison is made of the color of the tube and some known source of light which could be standardized. This gave indications within ten to twenty degrees centigrade. Satisfactory results were obtained, using quantities of material as small as 0.2 to 0.1 of a milligramme. The work has not as yet been carried very far.

In the discussion, Dr. Bancroft pointed out that the usual methods of measuring vapor density at ordinary temperatures were far from satisfactory, and the obtaining of such excellent results with this new apparatus must be regarded as a triumph of research work. Dr. Bancroft then read a paper upon "Electrical Endosmose," in which he described the action of diaphragms.

Dr. L. A. Parsons read a paper upon "Ions and Electrons," which discussed briefly the work of J. J. Thomson and others in this line.

A paper was next read by Mr. Carl Hering, the title of which was "Uniformity in Electrochemical Equivalents." He held that whenever absolute accuracy is not possible, the next best thing is uniformity, and advocated the temporary adoption of the certain constants. Uniformity could readily be obtained by adopting the set of atomic weights which has been adopted by the American Chemical Society, and the electrochemical equivalent which has been adopted internationally. The adoption of these two authoritative data would give a complete set of electrochemical equivalents.

In the discussion it was held that as the adopted value of silver does not seem to be correct, it was better not to adopt units which were known to be incorrect.

Dr. Bancroft then read a paper entitled "The Electromotive Force of Alloys," in which the changes occurring in the electromotive force of alloys during electrolysis were discussed.

Professor C. F. Burgess read a paper prepared by himself and Dr. Carl Hambuechen, entitled "Electrolytic Production of Metallic Compounds." The inaccuracy of much literature upon the subject was referred to, and reasons of failure and limitations were discussed. By means of electrolysis the more expensive acids used in producing metallic compounds may be replaced by cheaper materials, and where the cost of power is not too great, an economy effected.

President Richards announced that a prize of $250 had been offered for the best paper upon the electrolytic treatment of rare minerals. This prize had been established by Mr. A. B. Frenzel, of Denver, who was willing to supply, in reasonable quantities, tungsten, iridium and uranium ores.

The election of officers was then announced by the tellers, all officers whose terms of office had expired being reelected.

Friday afternoon excursions were made to various points of interest in New York and vicinity.

On Friday evening the members of the society were the guests of the American Institute of Electrical Engineers, at a special meeting. At this Mr. W. J. Hammer delivered an illustrated lecture upon radium and other radio-active substances. A report of this meeting will be found on another page of this issue.

SATURDAY MORNING SESSION.

Professor Burgess, in the absence of the author, read Mr. J. G. Zimmerman's paper, entitled "The Electrodeposition of Metals Upon a Rotating Cathode." This paper discussed the advantages of a rotating cathode, and described the results which the author had secured in the laboratory. It was found that by rotating the cathode the current density could be increased considerably, and good deposits secured. For good results the peripheral

speed should be proportional to the current density. Work had been carried out with copper and nickel solutions. With the latter metal it was found possible to secure bright plating which required no polishing. Zinc was also experimented with, and it was found that only by preventing rotation of the electrolyte was it possible to secure good plating. This seemed to indicate that the results were brought about by the friction of the electrolyte upon the cathode, rather than the centrifugal action of the revolving liquid throwing off impurities.

Mr. Hering thought that the same results could be obtained by circulating the electrolyte, with less trouble; but others who took part did not agree with him. While, theoretically, there should be no difference between circulating the cathode and circulating the electrolyte, practically there might be considerable difference.

Mr. A. B. Marvin read a paper entitled "Electrolytic Conduction Without Electrodes." This described an experiment, for which a special transformer was constructed, and in which the primary consisted of a coil of wire and the secondary of a trough containing the electrolyte. No metal was used in the construction of this trough. An iron core of the shell type was built up about the primary and one end of the secondary coil, the latter extending considerably beyond the iron. This trough was U-shaped, the circuit being completed at the end away from the core by a glass tube, around which is placed a Gramme ring armature. Upon sending a current through the primary, and plugging up the glass tube so as to prevent a flow of current through the solution, a humming noise was heard in a telephone connected to the Gramme ring winding, this being due to leakage. Upon removing the plugs so as to complete the circuit, there was a decided change in the note given by the telephone.

Mr. N. M. Hopkins described an experiment which he had made, to obtain a current in an electrolyte without the use of electrodes. He used an open-coil transformer, the secondary of which was composed of a spiral of glass filled with the solution. This was attached by means of rubber tubing to a second spiral enclosed within an iron-lined calorimeter. Upon passing a current through the primary, a change of temperature takes place in the calorimeter. The experiment was not conclusive, as the effort might have been caused by magnetic leakage from the transformer.

Mr. W. R. Mott then read a paper prepared by himself and Mr. H. E. Patten, upon "Potentials of Zinc in Aqueous Solutions," which described the results of a large number of experiments.

Mr. W. McA. Johnson then gave some notes on electrolytic deposition, which discussed the behavior of electrolytically deposited nickel, and showed how the deposit might be prevented from dripping.

Mr. B. MacNutt described a laboratory electric furnace. This was made by binding together a bundle of electric arc carbons, connection being made by opening the stranded conductor and binding the strands in with the carbons. This bundle was bored out at the top to form a cup, into which was placed a graphite crucible bedded in the crushed carbon. The other electrode was a carbon rod lowered into the furnace. This furnace has been used satisfactorily with a difference of potential of forty volts, and currents of from 150 to 200 amperes.

The following papers were read by title: "Free Ions in Electrolytic Solutions," by Dr. W. R. Whitney, and "The Influence of Some Impurities in Salt Upon the Yield of Soda in the Amalgam Process," by J. W. Walker.

Mr. A. Eimer then exhibited some new apparatus, including several new types of electric furnace for laboratory purposes.

Saturday afternoon was given over to visits to various points of interest.

Saturday evening Dr. Richards read his presidential address. He took for his subject, "Conditions of Progress in Electrochemistry." In order that advancement might be made in electrochemistry, new facts must be discovered. For this end laboratories must be equipped, and capable men put in charge, and given time and means for conducting research work. There are at present in Germany fifteen chairs of electrochemistry and twelve well-equipped laboratories. For progress it was also necessary that a clearer understanding of the laws correlating facts should be had as well as more rational theories of the why and wherefore. Useful working theories were often more injured by the excessive zeal of their friends than by the criticisms of others. A theory is merely a statement intended to explain certain known phenomena, and to enable the student to investigate this subject intelligently and extend his knowledge. Theories should be revised when necessary, as nothing was a greater drag upon a science than a rigid adherence to an inadequate explanation. For the satisfactory progress of a science, an increasing application should be made of the facts, to the welfare of mankind, and scientific literature should be disseminated more widely, both through the publication of the proceedings of societies and the scientific and technical journals. Another necessity for progress was an increase in vision on the part of the scientist of the possibilities of scientific achievement.

After the address a vote of thanks was adopted by the society to the Chemists' Club for their hospitality in giving the use of its club house to the society, and to the German Liederkranz for the use of their club house for the reception and banquet; also to the American Institute of Electrical Engineers and to the plants and establishments to which visits had been made, as well as to the local committee.

Dr. Doremus then called attention to the coming German congress of applied chemistry, stating that America would stand next to Germany in representation and papers presented.

Mr. Percy H. Thomas then gave an excellent explanation of the action of the Cooper Hewitt converter, showing it in operation.

Dr. von Recklinghausen showed the Cooper Hewitt mercury lamp, and demonstrated its actinic properties.

Dr. McMurtrie, on behalf of the Chemists' Club, expressed the pleasure the club had had in entertaining the American Electrochemical Society, and hoped that this meeting would lead to cordial relations between the various organizations interested in electrochemistry.

President Richards then declared the meeting closed, after which an enjoyable kneipe was held.

Among those present at the meeting were: Dr. A. R. Ledoux, president of the American Institute of Mining Engineers; Dr. William McMurtrie, president of the Chemists' Club; Dr. Samuel Sheldon, president of the New York Electrical Society; Mr. F. A. Ringler, president of the German Liederkranz; Mr. Alois von Isakovics; Dr. Max von Recklinghausen; Professor Henry S. Carhart, of the University of Michigan; P. G. Salom, Philadelphia, Pa.; Dr. W. D. Bancroft, Cornell University; Edward R. Taylor, Penn Yan, N. Y.; Professor W. E. Goldsborough, Purdue University; Mr. Alfred H. Cowles, Cleveland, Ohio; Carl Hering, Philadelphia, Pa.; T. C. Martin, New York city; L. Baekeland, Yonkers; E. H. Mullin, New York city; C. J. Reed, Philadelphia; A. B. Frenzel, Denver, Col.; Dr. Louis Duncan, of the Massachusetts Institute of Technology; Mr. Edward Weston, Waverly Park, N. J.; Lamar Lyndon, New York city; Dr. Leonard Waldo, New York city; Mr. E. A. Sperry, Cleveland, Ohio.

Radium and Other Radio-Active Substances.

With a Consideration of Phosphorescent and Fluorescent Substances. The Properties and Applications of Selenium, and the Treatment of Disease by the Ultra-Violet Light.

AN EXTRA meeting of the American Institute of Electrical Engineers was held in the chapel of the College of the City of New York, Twenty-third street and Lexington avenue, on Friday evening, April 17. At this meeting the American Electrochemical Society was the guest of the American Institute of Electrical Engineers. In opening the meeting President Scott called attention to the comparatively slow development and application of electrical engineering, as engineers commonly regard it, with the very rapid development and application of electrochemical and physico-electrical observations. The discovery of a new element opened up the way into researches which were more refined and examined deeper into the forces of nature than all work gone before. It was, then, with peculiar interest that the members of the Institute were to have presented to them an exposition of an unfamiliar subject. He took pleasure in introducing Mr. William J. Hammer, who would discourse on the subject of "Radium and Other Radio-Active Substances, with a Consideration of Phosphorescent and Fluorescent Substances. The Properties and Applications of Selenium, and the Treatment of Disease by the Ultra-Violet Light."

The attendance was very large, and the greatest interest was manifested in the explanation and experimentation as set forth by Mr. Hammer. He exhibited a number of lantern slides, calling attention to the great possibilities of selenium, and performed various experiments which demonstrated the practical application of this material. Mr. Hammer had prepared an elaborate paper detailing the course of the address, and illustrating the points which he brought out during the course of his remarks. The great length of the paper would make it necessary for just a brief abstract, touching on the essential points of interest and instruction.

Taking up the subject of fluoresence and phosphorescence, Mr. Hammer said:

Sir George Stokes has given the name of fluorescence to the phenomenon which certain substances have of absorbing the very short waves of ultra-violet light which are invisible, and transforming them into waves of longer length, so that they become visible to our eyes. The lowering of the frequency of certain ultra-violet radiations, so as to render them visible, was known to Brewster, in 1833, and to Herschel, in 1848, the former terming it internal, and the latter, surface dispersion; but it was first explained and the name given to it by Stokes in 1852, after a form of fluorspar. In the case of fluorescence, the emission of the light lasts only as long as the substance is stimulated by the incident beam; but in the case of phosphorescence, the emission of light continues or persists after the stimulation has ceased. He then exhibited a variety of apparatus which demonstrated the stimulating of fluorescent and phosphorescent bodies, and these were passed to the audience for examination.

The Cooper Hewitt tube was shown, the peculiar actinic effect of which was called attention to; and this tube was also exhibited with the light rays intercepted by a screen soaked in rhodamin. This is the only substance which thus far, the author stated, had been found fluorescent in the light of the mercury arc.

In passing upon the probable production of a cheap form of light, Mr. Hammer quoted the study made by Professor R. P. Langley and F. W. Very, as to the value of the light given off by the tropical beetle, designated technically as "pyrophorus noctilucus." The light had been determined by the use of the Langley bolometer, and demonstrated practically that all the energy which its phosphorescence represents appears as light, and that the light given off by this insect is the most efficient light known, it being produced at about one-four-hundredth part of the cost of energy which is expended in the candle flame.

Among plants, phosphorescence was first recorded by A. Linnæus, whose daughter discovered it in the nasturtium plant.

Having considered certain of the phenomena of phosphorescence and fluorescence, Mr. Hammer then called attention to these remarkable substances which have recently been discovered, which have given off light the moment they are created, without having to be stimulated by any form of heat, light, electrical or other vibrations, so far as students of this subject were yet cognizant of. He referred to radium, polonium, actinum and thorium.

It was to the discovery by M. Henri Becquerel, in 1896, of the remarkable radiations emanating from uranium that this study owed its foundation. Great importance should, however, be attached to the previous investigations into the phenomena produced on the interior and exterior of vacuum tubes of various kinds, by such men as Varley, Hittorf, Crookes, Lenard, Rœntgen, Hertz, J. J. Thomson, Goldstein, Schmidt, Ebert, Puluj, Perrin, Villard, Wein, Weidemann, Majorana, Birkland, Deslandres, Poincaure, Edison, Tesla, Rowland and others.

Two important links in the chain were supplied by the experiments of Henri and Niewenglowski. The former showed that phosphorescent sulphide of zinc penetrated black paper and affected a photographic plate, similar to Rœntgen rays; and the latter in his experiments replaced the usual cover of a loaded photographic plate-holder by a thin sheet of aluminum. On top of this he placed four glass squares, sprinkled over with sulphide of calcium, rendered phosphorescent by exposure to sunlight. A jeweler's glass bell jar was put over each plate, and the whole apparatus was then placed in a dark room for twenty-three hours. On developing the negative, the plate showed an excellent image of the plates of glass, and the bell glass covers, which had been made through the aluminum, a substance heretofore supposed to be entirely opaque to light. Subsequently Professor Becquerel investigated the effect of phosphorescent substances on photographic plates.

Peligot in 1840 succeeded in isolating metallic uranium from the chloride. Well-known forms of it are also uranium arsenate, uranium carbonate, uranium niobate, uranium phosphate, uranium silicate and uranium sulphate. Uranium was first discovered in 1879 by the German chemist Klaproth, and he named it after the planet "Uranus." Samples of uranium produced in the electric furnace by Moissan were more powerful than any other form of uranium. Uranium, although widely distributed, is never found in large amounts, and forms several minerals. The commonest of these is uraninite, commonly known as pitchblende. This is a compound oxide, containing eighty-one and one-half per cent of uranium, four per cent of lead, and one-half per cent of iron, with oxygen and water; or sometimes magnesia, manganese or silicon.

The pitchblende which contains the largest per cent of radio-active material which has thus far been discovered, is the Bohemian pitchblende. It is also found in Saxony in small pockets, and a distinct vein of it has been found in Cornwall, England. Professor Curie also informed the author that he had secured some excellent radio-active pitchblende from Colorado, United States. The ore as mined in Cornwall yields from eighteen to twenty per cent of the metal, this being the most important source, and this is usually put on the market in the form of uranium sesquioxide, being largely used for giving porcelains a velvety black when heated in the annealing fire, and to some extent for imparting a greenish-yellow fluorescence to glass. It has also been suggested to utilize it, on account of its high resistance, in connection with incandescent lighting.

Following the original discovery of the Becquerel radiations in 1896, came the

discovery in 1898 of polonium, by Professor Pierre Curie and Madame Sklodowski Curie, who in investigating Becquerel radiations from uranium, found some samples in pitchblende, from which the uranium is extracted, which was more powerful than any uranium they had found, having four times the radio-activity of metallic uranium. Polonium is precipitated by hydrogen sulphide, and apparently loses its power much more rapidly than radium. The Curies have not been able to prepare any polonium in which the rays have been deviable, although Geitel has prepared a form possessing both deviable and non-deviable rays, and Elster states that when polonium is placed in a vacuum, the rays may be deviated by a magnet to a greater extent than those of radium.

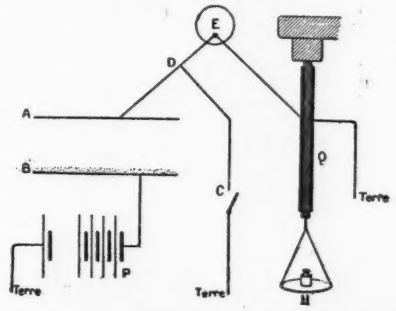
In the same year in which polonium was discovered, the Curies and M. Beamont succeeded in isolating a second substance found in pitchblende, which was associated with polonium, and possessed many of the chemical and other characteristics of that substance; and to this they gave the name radium. In 1899 a third substance was discovered in pitchblende, possessing the chemical and other of the characteristics of thorium, with which it was associated, and to this Debierne gave the name actinium.

Within the past month great interest has been attracted by the statement made by Professors Curie and Laborde, that radium maintains its own temperature at 1.5 degrees centigrade above its surroundings, this being equivalent to stating that half a pound of radium salt would evolve in one hour sufficient heat to equal that caused by the burning of one-third of a cubic foot of hydrogen gas, and that the heat evolved from pure radium is sufficient to melt more than its own weight of ice every hour. An atomic weight for radium of 225 has been determined, and the atomic weight of barium, heretofore always associated with radium, is but 157.

Several samples of radium, ranging from forty times the radio-activity of uranium, which is taken as a standard, up to 7,000 times the radio-activity of uranium, were passed about the audience, and Mr. Hammer stated that these substances are prepared in a laboratory under the control of Professor Curie, and up to recent date, all uranium of as high radio-activity as 7,000 has been retained for the experiments of the Curies and their associates. A notification has recently been received from the Société Centrale, informing the author that they will shortly put upon the market a preparation of radium, chemically pure, or nearly so, at a cost of 30,000 francs per gramme, or about $2,721,555.90 per pound. Radium, while it has been spoken of as a metal, has never been secured in a metal form, the usual form being as a chloride or bromide. Professor Curie has stated that the result of all the work done in Germany and France in the past three years had only resulted in the securing of about one pound of radium, this including all degrees of quality. Professor J. J. Thomson has stated that there is far more gold in sea water than there is radium, polonium and actinium in pitchblende.

As indicative of the enormous difficulties to be encountered in procuring this wonderful substance, it is interesting to note that it takes 5,000 tons of uranium residues to produce a kilo (2.2 pounds) of radium, and the cost of handling these residues is $2,000 per ton. To secure the chemically pure radium is enormously expensive, and it would be impossible to do this by chemical analysis. Therefore a far more sensitive electrical method is employed, and the statement is now made that the presence of radio-active substance can be detected by the means of such a minute quantity that it would require 5,000 times this amount to show at all in the spectroscope. It is also stated that this method of electrical analysis is thousands of times more sensitive than spectrum analysis, and millions of times more sensitive than chemical analysis.

The accompanying illustration shows the "electrometer" method with which the



Apparatus Employed by M. and Mme. Curie in the Study of Radio-Activity.

Curies have studied the radio-activity of different substances. It consists of two plates, A and B, on the latter of which is placed the radio-active substance to be tested. This makes the air a conductor of electricity between the two plates, and for measuring this degree of conductibility, the plate, B, is brought to a high potential by connecting it to one side of the storage battery, P, the other side of which is connected to the ground. If the plate, A, is brought to the potential of the ground by the wire, C-D, an electric current begins to flow between the two plates, A and B. The potential of plate, A, is shown by the electrometer, E. If we cut this communication with the ground at C, the plate, A, becomes charged causing the electrometer to deviate. The speed deviation is proportionate to the intensity of the current and can serve for measuring it. But it is preferable to make this measurement in compensating the charge taken by plate, A, so that the electrometer remains at zero. The charges which are extremely feeble can be compensated by means of Piezo-electric quartz, one armature of which is connected with the plate, A, and the other armature grounded. Quartz plate is given a certain tension by weights placed on the plate, H. This tension is gradually produced and gives a charge of a definite quantity of electricity which can be measured. The operation may be so regulated that there is a constant compensation between the quantity of electricity which passes through the condenser and that of the opposite sign furnished by the quartz. So we can measure in an absolute value the quantity of electricity passing through the condenser in a certain time.

Dolezalek has constructed an electrometer giving a deflection of 20,000 or more scale divisions for a potential difference of but one volt.

It is well known that the leaves of a gold or aluminum foil electroscope will hold their charge in dry air indefinitely; but the Becquerel rays are found to dissipate the charge by ionization of the air, and rendering the air a conductor of electricity (the electroscope may also be discharged by Rœntgen rays, cathode rays and ultra-violet light).

Elster and Geitel have shown that a thin wire of any metal, placed in the atmosphere and charged negatively from some source of current, causes the wire to become radio-active, and this radio-activity may be scraped off and will affect photographic plates, etc.

At the British Association meeting last summer Professor J. J. Thomson is reported to have stated that if a square centimetre of surface were covered with pure radium, it would only lose in weight one-thousandth of a milligramme in a thousand years. This is in accordance with the previous statements made by Becquerel. Later in the year A. Heydweiller, of the Royal University, Munster, Germany, made the statement that a small proportion of radium lost in weight 0.02 of a milligramme per day for fifty days, and a whole milligramme in that period. Professor Thomson, upon enquiry from Mr. Hammer, was inclined to think that from the magnitude of loss found by Heydweiller, it must be due to some secondary effect. Replies were also received from Henri Becquerel, Lord Kelvin, Sir William Crookes, P. Curie and A. Heydweiller, which would appear to eventually bear out the statements made by Professor Thomson. Several experiments, performed by Mr. Hammer, were then shown to illustrate the intensity of the radio-activity of radium preparations. In one showing the penetrative characteristics of the rays, a thick lead box was constructed, containing six tubes of radium, ranging from a radio-activity of 40 to 7,000. This box was laid upon a large steel magnet three-eighths of an inch thick. As may be seen from the accompanying illustration, the degree of penetration of both the lead and steel varies according to the radio-activity of the radium in the various tubes. The exposure was made in twenty-two hours. Various other demonstrations were exhibited, one particularly conclusive one showing a strip of black paper upon which had been mounted a number of substances, such as brass, iron, copper, tin, lead, tin-foil,

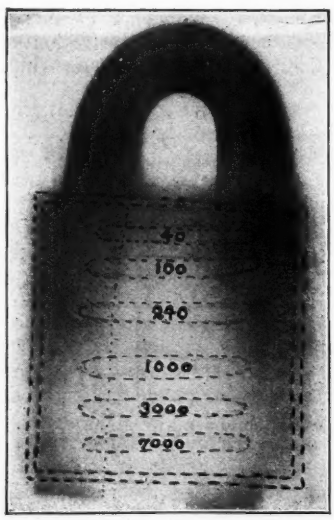
aluminum, magnesium, etc., and strips of carbon, vulcanite, glass, mica, and sulphide. When a plate was sprinkled over with sulphide of calcium, made brilliantly phosphorescent by exposure to burning magnesium ribbon, the only substances which allowed the light to pass through at all were the glass, mica, and sulphide, the other substances, including the paper, being very opaque. These substances were similarly arranged, but exposed to a tube of radium of 7,000 activity, which was placed three inches above the plate, and near the centre. The exposure was made for twenty-five hours. The strip of black paper was entirely transparent to the rays, and the various substances underneath it were penetrated to a greater or less degree, particularly those nearest to the radium.

Mr. Hammer then proceeded to describe the properties and applications of selenium. The Swedish scientist Berzelius discovered selenium in 1817, as a by-product from the distillation of sulphuric acid from iron pyrites. Its atomic weight is 79.5; specific gravity when crystallized, 4.788; its observed vapor specific gravity at 2,588 degrees Fahrenheit, 5.68. It is a non-metallic element which possesses characteristics similar to phosphorus, sulphur and tellurium. When melted at 212 degrees centigrade, and allowed to cool rapidly, it forms a brown amorphous mass of conchoidal fracture. In this connection it is a high-class insulator. It has been said that a small piece of it would represent the resistance of a wire stretched from the earth to the sun. When heated for quite a time at a temperature of 100 degrees centigrade, selenium becomes a conductor of electricity to a limited degree, this increasing with an increase of current, and varying according to the direction. Selenium has neither taste nor smell. The red vapor rising from it, when subjected to intense heat, is exceedingly poisonous, and care should therefore be taken when experimenting with selenium in liquid form.

Selenium is usually supplied commercially in a vitreous form. It is as structureless as glass and resembles black sealing wax.

In 1851 Hittorf first discovered the effects of temperature on selenium; but it was not until February 12, 1873, that Mr. Willoughby Smith sent a communication to President Latimer Clark, of the Society of Telegraph Engineers of London, calling attention to the effect of light in reducing the resistance of selenium. An assistant of Mr. Willoughby Smith, a Mr. May, who was a telegraph clerk at Valencia, called attention to the fact that some pencils of selenium which had been used to give a high resistance in connection with some of the cable-testing work conducted by Mr. Willoughby Smith, showed a marked change in resistance when the sliding cover of the box which held the selenium was removed, and the selenium was exposed to sunlight. These selenium pencils varied in length from five to ten centimetres, and were one to one and one-half millimetres in diameter; they were hermetically sealed in glass tubes with connecting wires of platinum at each end. Little credence was given to the original announcement; and it was only after Earl Ross verified this statement, and proved that the action was due solely to light, and showed the effects of the light of different portions of the spectrum, that it met with serious consideration. Since that time much work has been done in investigating the properties of selenium, especially by Messrs. Shelford Bidwell, J. W. Giltay, Lord Ross and Sale, Draper and Moss Hittorf, Adams and Day, Ayrton and Perry, Sir W. C. Siemens, Mercadier, Fritts, Minchin, Ruhmer, Webb, Bell and Taintor, and many others.

The most successful and most extensive experiments which have been made with the speaking arc are those of Mr. Ernest Ruhmer, of Berlin, Germany, who has



Radiograph Showing Degrees of Penetration of Lead and Steel by Tubes of Radium of Different Radio-Activities.

employed it in conjunction with his selenium cells for wireless telephony, and with remarkable success.

Selenium cells may vary in resistance from 2,000 ohms to 500,000 ohms or more in the dark; and certain cells may be five to twenty times as good conductors of electricity in light as in the dark; and in the case of other cells, notably that of the Fritts cell and that of the Ruhmer cell—used in his Wannsee experiments—will have 200 times the conductivity in light that it has in darkness; and the ratio may be even higher. They are usually made by winding carefully two separate lengths of wire, either of copper, brass, German silver or platinum, equidistant throughout their entire length, upon such substances as slate, glass, mica or porcelain. The selenium is then spread thinly over the wires, forming an insulation between the two windings.

Selenium cells are very susceptible to moisture, and it is largely this taking up of moisture which produces the electrolytic effect in the cell, enabling one to connect it with a galvanometer and produce a current by merely focusing the light upon the cell. This phenomenon gave rise to the designation of the photo-electric cell.

An important commercial application of the selenium cell has recently been made by Mr. Ernest Ruhmer in connection with his electrically controlled buoy, as here shown.

Pintsch has constructed a large number of buoys containing compressed gas, which would last from one month to upward of a year; but it was heretofore necessary to burn these lights day and night, it being often impracticable by reason of distance at which they were placed, and frequency of storms, etc., to switch off the gas so that it would not burn during the daytime.

Mr. Ruhmer has placed one of his selenium cells in the top of such a buoy connected with a switching device which, as soon as the sun rises in the morning, causes the selenium cell to reduce its resistance, this causing the switching device to turn off the gas, which is again turned on upon the increase of resistance of the selenium cell by the approach of nightfall, or if desired in the case of a storm coming up. A buoy containing sufficient gas for one month could thus be made to answer without recharge for from three to five months.

The arrangements of the circuits as originally devised by Mr. Ruhmer are shown. The voltmeter needle has been replaced by a relay, and the apparatus simplified. A single dry cell is interpolated in the selenium cell circuit, as usually employed on the buoy; and this cell will last a year or more; and with the relay, it is placed in the bottom of the buoy and arranged to be absolutely waterproof.

Mr. Ruhmer has also constructed an apparatus employing the selenium cell to which he has given the name "photographophone." The apparatus is shown diagrammatically. It consists of a box containing a gelatine or celluloid film, such as employed in moving-picture machines, and is driven at high speed by means of an electric motor. In the front face of the box is set a cylindrical lens about the size of one's little finger. A short distance away from the box is placed an arc lamp and a telephone. Words spoken or sung into the telephone superimpose the waves in the telephone circuit upon the current flowing in the arc light circuit, and cause a corresponding variation in the light of the arc. The rays from the arc lamp pass through the cylindrical prism already referred to, and are caused to fall in sharp white lines on the moving sensitive film. This film is then taken out of the box and developed; and then shows a series of perpendicular striations parallel to one another, which are really a photographic record of the sound waves originally entering the telephone. Where the striations are fine and close together, the pitch is high, but where they are broader and farther apart the pitch is low.

Strips of the film or photograms are shown. The developed film is next placed back into the box and the motor again started. The arc lamp remains in its original position, but burns steadily as the telephone is not operated. The rays

PINTSCH GAS BUOY, CONTROLLED BY A RUHMER SELENIUM CELL.

from the arc lamp passing through the lens are therefore quite uniform, and the moving gelatine strip acts as a screen to cut off these rays, allowing the light intermittently to fall upon the selenium cell at the back of the box, producing a variation in its resistance and a corresponding effect in the telephone receivers

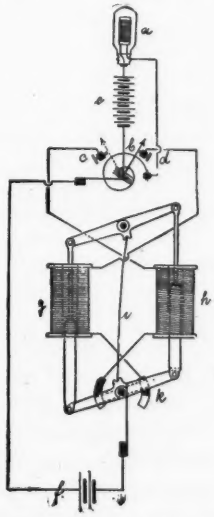


DIAGRAM OF CIRCUITS OF "SELENIUM" BUOY.

connected thereto. A battery is also interpolated in the circuit with the selenium cells and the telephones. By holding these telephones to the ear, the reproduction of the sound is perfect, the author can vouch for from personal experience with the apparatus.

Mr. Ruhmer contemplates utilizing this photographophone as a receiving instrument with its wireless telephone system, in which he employs a beam of light.

Selenium is found in Vesuvian lava, and in natural sulphur—as a sulphur selenide—in the Lispari Islands. It is also found in Norway and other iron pyrites. It occurs in meteoric iron and in such rare metals as eucarite as a selenide of silver and copper in Sweden and Chili; crooksite, a selenide of copper and thallium, with a little silver, from Norway; as clausthalite, a selenide of lead in the Hartz mountains, from Zinken and Clausthal, in Inverg, Rheinberg, Saxony, Rio Tinto, Spain, Mendoza, South America; as riolite at Culebras, Mexico; as Lehrbachite, a selenide of mercury and lead from the Hartz Mountains; as zorgite, a selenide of copper and lead from Glasbach, in the Hartz Mountains. Selenium, although widely distributed over the globe, occurs only in small quantities and in some instances is found in native state.

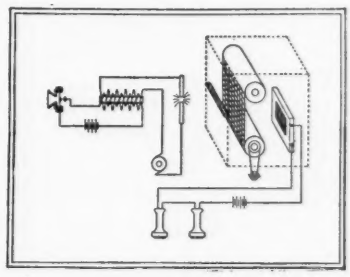
Selenium is placed among the rare metals. Chemically pure crystalline selenium costs about one dollar per gramme, and the ordinary commercial article about ten cents per gramme.

Dr. Neils R. Finsen has conducted very extensive and most painstaking researches into the bacteriacidal effects of light, and he has found both ends of the spectrum to possess remarkable curative powers.

The red rays have been used most successfully in the treatment of smallpox, and for the removal of such disfigurements as birthmarks, moles, etc.; and he has also found that by utilizing the blue, violet and ultra-violet rays at the other end of the spectrum, those loathsome diseases of tuberculosis of the skin and lupus, diseases which have baffled surgical skill heretofore, have been successfully combatted.

In affecting certain of the internal organs, tuberculosis is known as consumption, and appearing externally, attacking the skin and underlying tissues, it is known as *lupus vulgaris.* As a rule, it appears in single patches, most frequently attacking the face, especially the nose, cheek and mouth. It may, however, attack the extremities or, in fact, any portion of the body and even the mucus membranes. Fortunately lupus is rather rare in this country, although very common in Europe.

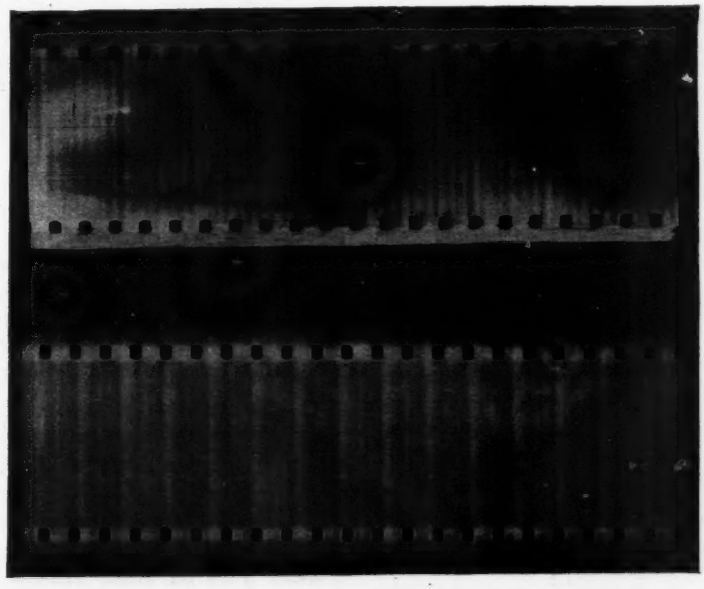
Koch and others have fully demonstrated that tuberculosis is due to the presence of specific organisms, named



SHOWING GENERAL ARRANGEMENTS OF CIRCUITS OF RUHMER'S PHOTOGRAPHOPHONE.

tubercle bacillus, which have been found to be present in both the internal and cutaneous forms of this disease.

Doubtless many remember the "blue-grass craze," which swept over the country in 1876, or thereabouts. A copy of



PHOTOGRAM AS USED IN RUHMER'S PHOTOGRAPHOPHONE (HIGH PITCH TONES ABOVE, LOW PITCH BELOW).

General A. J. Pleasonton's book entitled, "Blue and Sunlights; Their Influence upon Life and Disease," picked up in a second-hand bookstore some years ago, Mr. Hammer would commend the examination of this book to all who are interested in the subject. General Pleasonton and his system were condemned to both abuse and ridicule. Dr. Finsen, however,

says, "The General was absolutely on the right track."

For a considerable time, Finsen's work received little credence and no encouragement; but he persisted in his investigations, and the results secured by him finally bore fruit, and to-day the world rings with his praises. In all parts of the civilized world his work is being taken up, and institutes are being founded for the treatment of disease by light rays—particularly the ultra-violet light. In England the initiative was taken by Queen Alexandria, and in Russia by her sister, the Czarina, they both investigating the system while visiting their father, the King of Denmark. Much has also already been done in the United States. As an evidence of the importance attached to his work, he would call attention to the fact that Professor Finsen has recently received the "Noble" prize of $50,000 as a reward for his contributions to surgery and medicine.

Doubtless the rays emanating from the sun are very rich in blue, violet and ultra-violet light; but the atmosphere readily absorbs these rays, and while Professor Finsen for a time used the sun's rays in the treatment of tuberculosis of the skin and lupus he found that by employing the arc light the same effect could be produced in a very much shorter space of time; and that he was in this way, also, independent of weather conditions.

The arc light is much richer in ultra-violet rays than the sunlight; and Broca and Chatin, of Paris, have found that by placing an iron core inside of the positive carbon electrode, this arc was still richer in ultra-violet light, and Görl, of Erlangen, has constructed a form of aluminum arc, in which four arcs were formed between five aluminum electrodes. A modification of Görl's lamps, in which there are four iron electrodes forming three iron arcs in series, which produce an intense source of ultra-violet light, was shown in operation.

Bang and others have also made arc lamps employing terminals of iron. It is claimed that by employing the iron arc the same results which take an hour and ten minutes by means of the carbon arc can be accomplished in twenty minutes to half an hour; and also that so intense are these ultra-violet rays it is not necessary to use pressure to drive the blood away from the diseased part, and it is also unnecessary to use water to cool the rays.

It is said that out of over 600 cases treated at Copenhagen, there have been practically no failures due to fault in the treatment, but there have been cases where the disease has been in such an advanced stage and for such a very long period that it has not yielded successfully.

Mr. Hammer and his assistants demonstrated each detail with great cleverness and exhibited a fine array of experimental apparatus. After the lecture a number of the scientists and engineers present inspected the apparatus, and conducted a number of experimental tests.

The Magnetic Club Dinner.

The Magnetic Club gave a dinner at the Vendome Hotel on Saturday evening, April 18, to Colonel Robert C. Clowry, president of the Western Union Telegraph Company. About 250 persons were present, the greater number of these being operators in either the Western Union Telegraph or the Postal Telegraph companies. Besides Colonel Clowry, the guests included Vice-President Wm. H. Baker and A. B. Chandler, Melville E. Stone and H. D. Estabrook.

Colonel Clowry was introduced by Mr. F. W. Jones, president of the Magnetic Club.

Colonel Clowry spoke at some length on the subject of telegraph operators meeting with success. The training which young men received in discipline, accuracy and integrity was the means of modeling men of sound understanding. Other speakers were Mr. H. D. Estabrook, counsel of the Western Union Telegraph Company; A. B. Chandler, chairman of the board of directors of the Postal Telegraph Company; Melville E. Stone, general manager of the Associated Press, and Francis W. Jones, president of the Magnetic Club.

Philadelphia Branch American Institute of Electrical Engineers.

The second meeting of the Philadelphia branch of the American Institute of Electrical Engineers was held Monday, April 6, at the Engineers' Club, of Philadelphia.

Mr. Carl Hering, the chairman, made a short opening address and, after necessary business was transacted, Mr. Hewitt presented Mr. F. O. Blackwell's paper on the "Testing of Insulators" and Mr. Ralph D. Mershon's paper on "Mechanical Specifications for a Proposed Standard Insulator Pin." Mr. P. M. Lincoln, of Pittsburg, presented and discussed a paper by himself on "Transposition and Relative Location of Power and Telephone Wires."

Mr. H. H. Barnes, of Pittsfield, Mass., presented a paper on the "Burning of Wooden Pins on High Tension Transmission Lines," written by Mr. C. C. Chesney.

Mr. W. L. Hodges, the chief engineer of the Keystone Telephone Company, gave a brief résumé of the New York discussion of Mr. Lincoln's paper. Mr. Hodges disagreed with Mr. Gerry's statement, that the ordinary telephone lightning arrester was an undesirable and unsafe piece of apparatus for properly taking care of telephone circuits. Mr. Hodges stated that he had had considerable experience with different types of arresters and found some that answered admirably. He stated that it must not be expected that an ordinary lightning arrester should be sufficient in extraordinary cases.

Mr. Hodges discussed the various difficulties liable to arise where telephone and high-tension circuits are run on the same poles.

Mr. H. F. Sanville then gave an abstract of the New York discussions of the papers of Messrs. Blackwell, Mershon and Chesney.

The general discussion followed, during which a spirited controversy between Messrs. Lincoln and Hodges was carried on, regarding the electrostatic effect through a telephone receiver, due to the electrostatic effects of the main transmission line, Mr. Lincoln maintaining this is a constant-current effect, and Mr. Hodges taking the stand that it is a constant-potential effect.

Mr. Barnes, of Pittsfield, Mr. Theodore Spencer, Mr. Washington Devereux, Mr. C. B. Fulton, Mr. J. Silliman, Mr. R. L. Binder, Mr. Charles Hewitt, Mr. Hutchins and Mr. Carl Hering took part in the general discussion.

Mr. W. C. L. Eglin gave a short talk on the action of the joint committee of the American Institute and the National Board of Fire Underwriters, which had met recently in Boston.

The next meeting of the branch will be held on Monday evening, May 11. The subject of the meeting will be "The Tendencies of Central Station Development."

After the general discussion, the meeting was much interested in samples of the latest type of high-tension insulators, which had been sent for exhibition by the R. Thomas & Sons Company, of East Liverpool, Ohio; the Locke Insulator Manufacturing Company, of Victor, N. Y., and C. S. Knowles, of Boston.

National Electric Light Association.

Efforts are being made to secure a special train to run from New York to Chicago, for the benefit of members, delegates and friends attending the twenty-sixth convention of the National Electric Light Association. This will be held in Chicago, May 26, 27, 28.

Municipal Lighting Bill Killed in New York.

The New York State Senate, by a decisive vote, has agreed to an adverse report from the Cities Committee upon Colonel Robert Grier Monroe's municipal electric lighting plant bill for New York city.

The Colorado Springs & Interurban Street Railway System.

A Description of the Electrical Equipment and the Power Installation.

By J. H. Rusby.

THE entire plant and system of the Colorado Springs & Interurban Street Railway Company were built, owned and operated by the late W. S. Stratton, the discoverer of the famous "Independence" mine of Cripple Creek, and are still operated by his estate. The system embraces, in addition to the Colorado Springs service, regular running schedules to the following outlying points: Cheyenne Cañon, Broadmoor, Manitou, Knob Hill, Prospect Lake, and the Deaf and Blind Institute. Mr. D. L. McCaffrey is the general manager of the system, and it is to him that we are indebted for the following description.

THE POWER-HOUSE.

The power-house of the system is located at the corner of Rio Grande and Sierra Madre streets, and is a brick structure 164 feet 6 inches long by 97 feet wide, divided into two sections by a brick fire wall, the engine room section being 164 feet 6 inches long by 48 feet 6 inches wide and the boiler room section 164 feet 6 inches long by 46 feet 6 inches wide.

The building is built upon a concrete foundation throughout, and the same material is also used in the foundation for the boiler, engine and generating units. The roof is of steel girder construction, on which is laid hollow tile covered with one inch of cement with pitch and gravel roof laid on top of cement, making a perfectly fireproof roof.

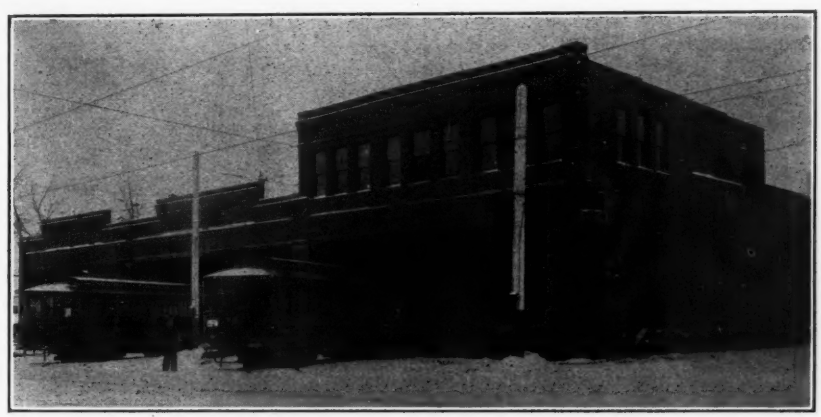
The boiler room contains six Cahall water-tube Babcock & Wilcox type boilers, as follows.

Four 2-drum, 16-section, 9 tubes to section; two 24-foot by 42-inch drums with grate surface of 66½ square feet. Nominal rating 300 horse-power each; with 144 tubes, each 20-foot by 4-inch diameter. Two 3-drum, 21-section, 9 tubes to section; with 24-foot by 42-inch drums, with 189 tubes, each 20-foot by 4-inch diameter. Nominal rating 400 horse-power each.

Two single Marsh pumps, 12 feet by 7½ inches by 12 inches. One 400-horse-power special Cochrane heater for heating feed water.

The steam main that supplies the engines with steam from boilers is placed on boiler room side of dividing wall and behind the boilers upon special brackets to leave it free to expand and contract.

There is also installed in the boiler room a coal and ash conveyor for the handling of all the coal and ashes. The coal is shipped from the mines in steel hopper-bottom cars, bought by the company for this service. The coal is dumped from the cars into a hopper built under the tracks, and passes through a crusher for the purpose of making the coal all of one size. It is then taken by a cross-conveyor to a longitudinal conveyor which runs the full length of boiler room (164 feet) and carried to the top of the building, and there deposited into six steel bins which have a capacity of twenty-five tons each. It is taken from these bins by the firemen as needed, requiring no handling by hands. The ashes are also removed by the same method, being taken from the ash-pits to the top of the building and deposited in a steel bin and then taken in cars, provided for that purpose, to points on the road and used for filling.



CAR HOUSES, COLORADO SPRINGS & INTERURBAN STREET RAILWAY SYSTEM.

The steel stack by which the draft for the boilers is obtained is self-sustaining, being built upon a concrete foundation 25 feet by 25 feet, and to a depth of 10 feet below the boiler room floor. The concrete also extends 32 feet above the floor, making the foundation 42 feet high by 25 feet in diameter. The steel part of stack is anchored to the concrete by sixteen 2½-inch rods 42 feet long, extending to the bottom of foundation and fastened to T-rails. The steel part of stack is 152 feet high and is made up of three different sizes of steel plate—70 feet of one-half inch steel, 50 feet of three-fifths inch steel and 32 feet of three-sixteenths inch steel, and is 10 feet inside diameter. The total height of stack above the boiler room floor is 184 feet.

THE ENGINE ROOM.

The engine room is 164 feet 6 inches by 48 feet 6 inches and is equipped for railway power with the following units:

Two (one left and one right hand) Allis-Chalmers Corliss engines, 28 inches by 46 inches; two wrist-plates with 60,000-pound flywheels, normal capacity 750 horse-power, direct-connected to General Electric, 10-pole, 500-kilowatt, 575-volt, 670-ampere railway generators, having a normal capacity each of 670 electrical horse-power.

One right-hand Allis-Chalmers Corliss engine, 22 inches by 42 inches; two wrist-plates with 46,000-pound flywheel, normal capacity 450 horse-power, direct-connected to one General Electric 8-pole, 300-kilowatt, 575-volt, 522-ampere railway generator having a normal capacity of 402 electrical horse-power.

One Allis-Chalmers Corliss compound engine, cylinders 18 inches by 32 inches and 42 inches, 100 revolutions per minute, with a 50,000-pound flywheel, normal capacity of 450 horse-power, direct-connected to one General Electric, 72-pole, 300-kilowatt, 6,600-volt, 26-ampere, 60-cycle, 3-phase alternator.

One General Electric marine type compound engine, 7½ inches by 12½ inches by 6 inches, 400 revolutions per minute, direct-connected to a General Electric continuous-current generator, 35-kilowatt, 6-pole, 125-volt, for exciting the fields of the alternating unit.

There is also a 50,000-pound capacity traveling crane, made by the Whiting Foundry Company, of Chicago, which

travels the full length of engine room, and by which the different parts of engines and generators (some of which weigh 56,000 pounds) were put into place, and which is necessary for making repairs.

There is also installed a gravity system of oiling whereby the oil is placed in steel tanks fastened to the roof girders and piped to the different bearings of engines and generators, and after being used through the bearings it is piped to a filter, and there all the dirt and foreign matter are taken out and the oil pumped back up to the storage tanks again, using the same oil over and over again.

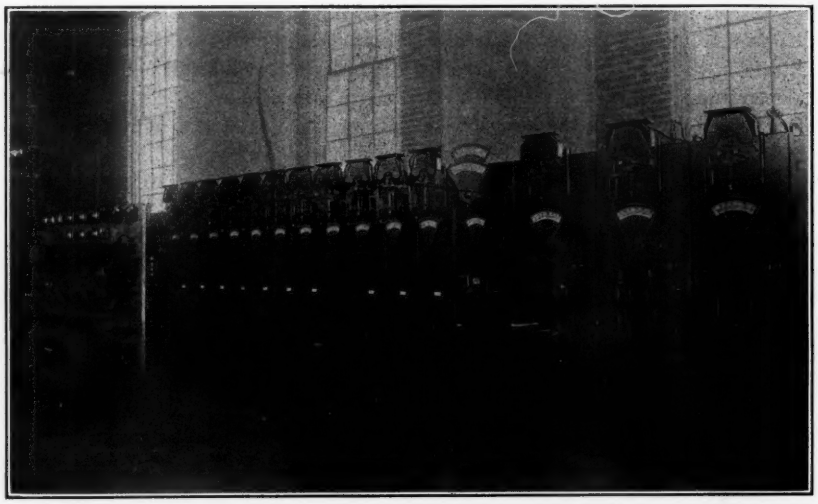
All of the steam pipes are connected with the Holly system of return, whereby all the water from condensation is returned to the heater and used again in boilers.

The floors of the engine and boiler rooms are of concrete, the boiler room floor being laid on the gravel, and that of the engine room is what is termed a 6-inch suspended concrete flooring with top dressing, leaving a basement below of 8 feet head room where all the cables and wires from the generators to the switchboard are run; there being two switchboards, one each for the railway and light circuits.

THE SWITCHBOARD.

The railway switchboard is equipped as follows: Three 500-kilowatt machine panels for handling each generator; one totalizing panel with recording wattmeter for measuring the amount of current used each day; volt and amperemeters, so that the attendant can tell at a glance what the lines are doing; eleven feeder panels for feeding the different lines. These panels are made of slate, enameled black and finely finished.

The lighting switchboard consists of one exciter panel; one alternator panel; three circuit panels for alternating multiple lighting, and one circuit panel for series arc lighting. This board is built of blue Vermont marble, and is fully equipped with all necessary instruments, transformers, etc.



SWITCHBOARD IN POWER-HOUSE, COLORADO SPRINGS & INTERURBAN STREET RAILWAY SYSTEM.

This switchboard, with the railway board, was installed by the General Electric Company.

The cost of building, without machinery, was $74,274.99.

BUILDINGS.

There are two brick car houses, 180 feet by 50 feet, for storage of cars, with a capacity of thirty-two double-truck cars.

BOILER ROOM IN POWER-HOUSE OF COLORADO SPRINGS & INTERURBAN STREET RAILWAY SYSTEM.

One brick car house, with office rooms on second floor, 180 feet by 50 feet, with steel girders; three open-pit tracks, where repairs on trucks and motors are made, and with a storage capacity of sixteen double-truck cars.

Two brick buildings, with steel girders for support of roof, cement floors, each 190 feet by 60 feet. One is used for the carpenter shop and paint shop. The carpenter shop is 60 feet by 75 feet, and is equipped with a wood planer, band-saw and other necessary tools, the motor which furnishes the power being placed under the floor in a concrete pit with all the shafting, so that there are not any belts or shafting above the floor, making a very neat and complete shop. The paint shop, which is 50 feet by 115 feet, has three tracks, and six of the large double-truck cars can be painted at one time. There is a 12-foot 6-inch skylight running the full length in centre of building, making a very light and pleasant building in which to work.

The other building is used for a machine shop, storeroom and armature room. The machine shop is 60 feet by 130 feet, and contains the following tools: One 50-horse-power, General Electric, multipolar, shunt, continuous-speed, 500-volt motor, belted to a Sergent-Ingersol compound automatic air compressor, having a capacitv of 200 feet free air per minute. It is also belted to a line shaft running at right angles to shop, which runs a 24-inch Lodge & Davis drill press, a combination punch and shear, shearing 6-inch by 1-inch steel and punching a 1-inch hole in 1-inch steel, a Newton cold sawing machine for cutting off rails at any angle, a small iron planer, emery wheel, large grindstone and blower for blacksmith's forge. The main line shaft runs the full length of the machine shop. In the centre of the building it is in two sections, one section running wheel machinery, which consists of the following machines: One 150-ton hydraulic wheel press, Watson-Still-

man pattern; one Putnam wheel-boring machine, which will bore and face from 15-inch to 40-inch wheels; one axle lathe, Putnam improved, with crane for taking axles in and out of lathe. This section of the line shaft does not run when the wheel-boring machinery is not in use.

The other section of main line shaft runs a 36-inch Bickford radial drill, one 26-inch J. B. Reed lathe, one 14-inch Prentice Brothers lathe, one 30-inch shaper, one automatic saw sharpener, one twist-drill grinder, one diamond tool grinder, and one car-wheel grinder for truing old and new wheels.

The storeroom is 35 feet by 66 feet, and contains everything that is used in the repairs and maintenance of the track, overhead, motors and cars of the company.

CAR EQUIPMENT.

The car equipment of the company consists of the following cars and motors:

Fifteen open Narragansett type Brill double-truck cars, equipped with 27-foot Brill trucks, and four General Electric motors, giving a total of 152 horse-power per car.

Nine closed and one open double-truck cars, built by the Laclede Car Company, equipped with Milwaukee trucks, and with two General Electric 38-horse-power motors and A1 suspension trucks.

One single-truck line car, equipped with two steel motors and old-style McGuire trucks.

One double-truck work and snow-plow car, equipped with Milwaukee trucks and four General Electric 38-horse-power motors.

Two single-truck Taunton snow-plows (closed), equipped with two General Electric 38-horse-power motors, taken from open cars.

Two open flat push-plows.

Three flat double-truck work cars or construction cars.

ENGINE ROOM IN POWER-HOUSE, COLORADO SPRINGS & INTERURBAN STREET RAILWAY SYSTEM.

The above shaft is driven by a 12-horse-power Edison bipolar shunt-wound motor. There is also a 15-horse-power Sprague motor for emergencies, belted up and ready to run in case of a burnout on either side of the motors. There are also three blacksmith forges and one furnace for melting babbitt metal for refilling the different bearings of the motors and cars. There is also a standard-gauge track running through the machine shop and into the storeroom for the handling of supplies, etc.

The armature room is 25 feet by 50 feet, and is used for winding the armatures and fields and the different electrical parts on the cars. The different air valves and pipes are also tested for leaks, etc., in this room.

four General Electric motors, giving a total of 152 horse-power per car.

Five closed Brill convertible patented type of car, equipped with 27-foot Brill trucks, and four General Electric motors, giving a total of 152 horse-power per car.

Fifteen 16-foot Pullman closed cars.

Two 24-foot Pullman closed cars, equipped with two 30-horse-power steel motors, and old-style McGuire trucks.

Two 30-foot combination cars (part closed and part open), equipped with two 30-horse-power steel motors and McGuire suspension trucks.

Two 24-foot combination cars, equipped with two Edison No. 16, 30-horse-power motors and McGuire A1 suspension trucks.

Three single combination cars, equipped

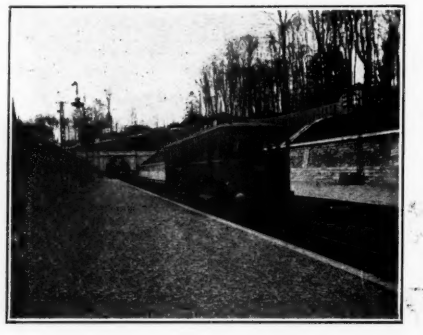
Thirteen open, eight-bench train cars, equipped with old-style McGuire trucks.

The latest method of hardening the face of armor-plate is by heating the face with electrical currents by means of large carbon anodes instead of applying the heat in a furnace. It has been found that during the electrical treatment a portion of the carbon of the anodes enters into the composition of the steel, producing great hardness of that metal. The depth to which the hardening proceeds is regulated by the length of time during which the treatment is applied. It is claimed to be superior to the Harvey system or that of Krupp. By the latter process plates require fifteen to twenty days' treatment. With the electrical method the desired result is accomplished in five hours.

Electrical Notes from Europe.

By Our Special Correspondent.

THE new railroad line from Paris to Versailles which has been recently opened, must be added to the number of European lines which employ electric locomotives for the regular service. The present line is double track, standard gauge, and has a total length of eleven miles, using electric locomotives exclusively. The line starts from a large underground depot and runs along the bank of the Seine, and then branches to the left after leaving the city limits. The construction of the road has been difficult, owing to the nature of the country, and includes one and one-half miles of viaducts, and a tunnel two miles long which was pierced below the Meudon Woods. Owing to the large amount of construction the first seven miles of the road cost $5,200,000, or about $740,000 per mile, exclusive of the electric material or rolling stock. The trains are made up of standard railway cars and are drawn by specially built electric locomotives. These are of two distinct types; the first being an electric locomotive proper, while the second is a motor car of the type used on the Paris Metropolitan, having a cabin at one end and the rest of the car for the passengers. One of the locomotives is shown in the photograph, with the portion of the track near the Meudon tunnel. These locomotives can draw a 140-ton train at thirty to forty miles an hour. They have been built by the Société des Locomotives Electriques, and are mounted upon two trucks of two axles each. At either end is a compartment for the motorman with the various controlling devices, while the middle space can be used for baggage. The locomotive measures forty-two feet in total length. A motor is mounted on each axle and these can be coupled in series by groups of two, or all four in parallel. At present there are ten locomotives of this form in use, and the electrical outfit is of two kinds, differing in the form and disposition of the motors. On four of the locomotives Thomson-Houston motors, built at the Paris shops, are used; these are single-reduction motors. The six other locomotives have direct driving, and three of them use Westinghouse and the remainder Brown-Boveri motors. In the gearless motors the armature is wound on a hollow shaft, and through it passes the main axle which is connected to the armature by a coupling of three elastic springs, these being fixed to the wheel. The motor cars which the company is now trying are equipped with Sprague and Thomson-Houston outfits and use single-reduction motors. The current for the locomotives is taken from a third rail by a set of contact shoes. The rail is formed of fifty-foot sections, and is partially enclosed by wood strips. The rail is divided electrically into a number of sections which are separated by a short gap filled up to the level with wood. The ends of the rail are connected by cables to a section-box containing a switch. The current for the line is supplied from the large station at Moulineaux, which delivers three-phase current at 5,000 volts



PARIS-VERSAILLES ELECTRIC LINE.

to the substation along the route, and here the tension is lowered to 550 volts direct current by rotary converters.

A new hydraulic plant is now being erected at Clermont-Ferrand, which is the centre of the rubber industry in France, and has a large number of works. The current will be used to operate a number of these establishments, and there is no doubt that new ones will be erected as soon as the hydraulic plant can furnish the power. The current will also be used for lighting the town. The generating station is located on the banks of the Sioule and will use 6,000 horse-power from this stream. The dam which is just above the station is ninety-five feet high, with an average width of eighty feet. Above the dam the river is widened and forms a reservoir three and one-half miles long and 350 feet in average width. The head of water is from sixty-five to eighty feet, according to the season, with an average supply of 270 cubic feet per second. During the freshets, which are caused by the melting of the snow, the supply is greatly increased. The water is brought to the turbines by a number of penstocks which are built directly into the masonry of the dam, each of these supplying a separate turbine. The latter are direct coupled to three-phase alternators of 800 kilowatts. The machine gives 1,000 volts and works at 330 revolutions per minute, with a period of fifty cycles. A set of smaller turbines is used to drive the exciters, with direct coupling. The current is raised to 20,000 volts in the station by a set of six monophase transformers, giving 375 kilowatts each. The transformers are contained in oil boxes and are connected three in a set for the three-phase system. The double line, twenty-seven miles long, which runs to the centre of distribution is mounted on wooden poles. The cross-arms supporting the insulators are boiled in paraffin and then coated with tar. The work on the dam and the generating station has been carried on actively during the last year and is now nearly finished. The electrical outfit of the station is to be supplied by the Westinghouse Electric Company, from the works at Havre, and the line is to be erected by the same company.

Among the new electric companies which have been formed in France is the Compagnie Electrique de Menton, which has for its object the installation of a light and power system of distribution in the town of Menton and the adjacent points on the Mediterranean coast. It is to build a plant for this purpose and will undertake the sale of current for light and power. The company is to have fifty years' duration, starting from November last, and is capitalized at 800,000 francs. Another new company is the Société Indo-Chinoise d'Electricité, which is formed for the purpose of obtaining concessions of light and power in the various French colonies and protectorates, and especially in Indo-China, including the centres of Haïphong and Hanoï. The company is capitalized at 2,800,000 francs. The J. Holden Company has been recently formed for the manufacture of accumulators, especially the new type known as the "Max" accumulator, which is to be introduced in France and other countries. It is capitalized at 500,000 francs.

Next to Switzerland, the mountainous

region in the southeast of France is taking the lead in the number of hydraulic plants which are being erected for various purposes. Among the most important plants which are used for the electrochemical industries is that of Clavaux, which lies at twenty miles from Grenoble and is supplied by a branch canal from the Romanche River. The Société d' Electrochemie, which utilizes the plant for the production of sodium and oxides of soda, also controls the hydraulic station of St. Michel de Maurienne and that of Vallorbes, which are used in the manufacture of chlorates, perchlorates and other compounds. The Clavaux plant uses a fall which varies from 540 cubic feet per second during eight months of the year down to 200 or 250 in the winter months. From the basin formed by the dam, a deviation canal, which is thirty-five feet wide and 260 feet long, takes the water into a vast basin with inclined bottom which allows the speed of the current to be reduced in order to deposit the sand. The latter is taken off at the side through a series of gates. The basin ends in a wall fifteen feet thick, from which starts the main penstock, which is protected by a grating. The penstock is formed of a steel tube of eight feet internal diameter, being one-quarter inch thick at the upper end, which increases to half an inch at the lower end, near the turbines. It runs for 3,500 feet and is supported upon masonry pillars. As there are a number of elbows in the pipe, these take up the expansion and contraction. The total head of water is 136 feet, of which 115 are utilized for the turbines. The station contains five direct-coupled generating groups, using horizontal turbines of 550 horse-power which work at 250 revolutions per minute. The turbines have been supplied by Neynet Brenier & Company, of Grenoble. They are coupled to dynamos of 375 kilowatts and there is also a smaller eighty-kilowatt set which is used for the lighting and also to supply a number of motors on the premises, ranging from five to fifty horse-power. The dynamos give direct current and are of different makes, including two Thury-Creusot machines of twelve poles, two Creusot six-pole machines, and two of the Alioth make of twelve poles. The dynamos have two separate commutators, each of which can supply a current of 2,500 amperes at seventy-five volts. The station is used exclusively for the manufacture of electrolytic products, among others pure sodium and peroxide of sodium by the Castner and Hulin process, besides the higher oxides of sodium which are used to form the new compound known as "oxylith," lately brought out by Dr. Jaubert. This compound is used to form pure oxygen by direct contact with water, analogous to the action of carbide, and is now being produced on a commercial scale.

Some interesting experiments on the conductivity of compressed powders have been made by a German scientist, F. Streintz. The powders are placed in ebonite tubes and submitted to various temperatures and pressures. In case the temperature is too high to allow ebonite to be used, the powders are compressed into blocks or cylinders where possible, and from these take various forms according to the material. Some of the powders form rods which possess a considerable cohesion and are almost as brilliant and as hard as metal. Their conductivity is therefore high, while in the pieces having a dull surface and little cohesion the conductivity is much lower, and seems thus to depend upon the cohesion of the particles. To make the measurements at high temperatures the pieces are placed in a magnesia furnace, and an extreme cooling is obtained by placing them in liquid air. Metallic oxides and sulphides were chiefly used in the experiment. The highest conductivity was remarked in the case of lead oxide, and its resistance increases with the temperature. Black oxide of manganese has a much less conductivity and its resistance decreases with a rise of temperature, the coefficient being high. The oxides of various metals behave quite differently, and while the above are found to be conductors, on the other hand cupric oxide, magnetic oxide of iron, sesquioxide of nickel and cobalt and oxide of uranium are not conducting when in the powdered state. As to the sulphides, those of nickel, iron and lead in the amorphous state are non-conductors, while in the case of copper and molybdenum sulphides and the black sulphide of mercury, galena and silver sulphide, the conductivity is relatively considerable. Silver sulphide is found to have remarkable properties under these conditions. Whatever may be its physical state, the variation of conductivity with the temperature remains the same, while cyclic variations of temperature change its physical state and bring it to a condition where its normal resistance at the ordinary temperature is diminished. The experiments showed that the conductivity of the silver sulphide rises so rapidly with the temperature that the heat produced in the mass by the current itself is sufficient to still further raise the conductivity; at 220 degrees centigrade, the resistance is comparable to that of metals, no decomposition being produced; however, it was observed that a counter-electromotive force is produced here which is somewhat analogous to the effect of polarization. The compressed powders were also tested in liquid air and their conductivity is very low in this case. It was also found that the magnetic field had no effect upon the conductivity of the powders.

The application of electromagnets in connection with large cranes for the suspension of loads in iron works, blast furnaces, etc., is being taken up in France by the Compagnie Internationale d'Electricité, which is now occupied in designing various forms of magnets for this purpose. The first pattern is an enclosed magnet, which is formed of an external cylinder into which is fitted an inner core. The coil occupies the annular space and the magnetic circuit is completed by the piece to be lifted. The coil is thus entirely protected by the outer parts. The second pattern uses two such electromagnets suspended at the ends of a bar, the middle of which is hung from the crane. The magnets can thus take up pieces of considerable length. The current is taken by rubbing contacts from two wires stretched alongside the crane.

At a recent meeting of the Société de Physique, M. Dauve presented a new form of high resistance which is obtained by tracing lines with aluminum upon a ground glass plate. The line is produced by passing over the glass two or three times a piece of aluminum which is cut in the form of a chisel and is guided by a rule. The metallic layer thus formed is conducting, but has a high resistance. The contacts are easily made by applying a piece of tin-foil to the ends of the line, pressing it in a metallic clamp which is provided with a binding-post. The line is then covered with a suitable varnish, that of Judæa bitumen being preferred. The resistance which is thus obtained is found to give certain variations over a period of several months, but afterward it takes a fixed value. Such a resistance can be used to advantage in many cases where a high resistance of German silver wire would be too expensive, and besides it is practically free from self-induction and capacity. C. L. DURAND.

Paris, France, April 11.

DISTRIBUTION LOSSES IN ELECTRIC SUPPLY SYSTEMS—II.[1]

BY A. D. CONSTABLE AND E. FAWSSETT.

Table IV gives the reduction in excitation energy in various cases, and it will be noticed that the saving is quite comparable with the loss by dielectric hysteresis; so that beyond the objection to running a larger generator than is required to supply the actual watts consumed, there is really no great loss due to the use of high-tension cables, at any rate at 2,000 volts. In the summary, however, dielectric hysteresis losses are included, as exciting energy is not considered in this paper.

TABLE IV.

Effect of capacity on exciting current.

	Voltage on Cable.	Exciting Current without Cable.	Exciting Current with Cable.	Watts Saved in Excitation.	Approximate Watts in Cable (paper).
A	10,000	5.8	2.5	426	2,000
	5,000	5.8	4.7	142	500
	2,000	5.8	5.4	52	80
B	10,000	17.5	13.2	555	2,000
	5,000	17.5	16.0	193	500
	2,000	17.5	17.2	39	80

A—30-kilowatt alternator. B—120-kilowatt alternator.

NOTE—In addition, there is a further improvement in the efficiency of the alternator, due to the effect of the altered wave-form on the armature losses.

The effect of variation of voltage is shown in experiments No. 15-20. It will be seen that with the particular form of wave applied, the current increases rather more rapidly than the voltage and the watts rather more rapidly than the voltage squared. This, of course, means that with very high voltages the watts absorbed may be a formidable quantity, but at the same time it must be remembered that as the voltage increases, so does the thickness of the dielectric. The capacity is therefore less, and, assuming no resonance, the cable volt-amperes and the watts absorbed will by no means increase as the voltage squared.

Some experiments were made on the effect of frequency, and the power-factor does not seem to be largely altered. As, however, there was some doubt as to the accuracy of the instruments employed in these tests, the figures are not here recorded.

The effect of load on the cable on this loss has not been satisfactorily investigated. It implies taking the difference of two very large quantities, compared with the loss, and is therefore not susceptible of much accuracy. In any case, the time during which the feeders in a lighting station are loaded is so small a fraction of the whole time they are running that the difference in the total result can not be large.

Taking a comprehensive view of the above results, there appears to be no doubt that in the case of the vulcanized bitumen insulated cable No. 7, the power-factor is of the order of 0.12, that of the jute-insulated cables about 0.025, and of the paper-insulated cables something of the order of 0.032 and 0.08 respectively for Nos. 10 and 11. The first three results are fairly consistent with all the statements made in the discussion on Mr. Mordey's paper. The vulcanized bitumen cable appears to be an exceptionally bad cable from this point of view, and the 5,000-volt paper cables appear to have a larger dielectric hysteresis loss than the jute cables[1].

It is noteworthy that the cable which shows an abnormally high power-factor—*viz.*, No. 7—is laid in an iron trough, with iron cover. It is possible that this iron trough, completely surrounding the counts to some extent for the high power-cable, accounts to some extent for the high power-factor. Where the cable is in an iron trough with a tile cover, as in the case of Nos. 10 and 11, the power-factor is also higher than would be expected from the type of cable. All the cables in experiment twelve have the outers of slightly larger sectional area than the inners—roughly, five to ten per cent larger. The fact that an external field exists round these cables is proved by the humming noise produced in the telephones connected to pilot wires laid parallel and close to the cables. That this noise is not due to leakage entirely is shown by the fact that it is slight during times of no load, and very loud at times of heavy loads. Public telephone cables along the same route, but further away from the lighting cables, are not appreciably affected.

Taking the values given above, the total hysteresis loss in the Croydon system of mains comes out at about 17,000 units per annum, and is approximately equally divided between the four quarters. This is not so large a loss that it is worth while shutting down feeders for the period of light load to reduce it considering the risks involved in so doing. It is most important, however, to decide on a dielectric which will not give an abnormal loss, as in the case of cable No. 7.

TRANSFORMER LOSSES.

The next point to be considered—and it is one of more importance than losses in the cable dielectrics—is that of transformer losses in an alternating-current supply. Table V gives the annual losses in the transformers necessary to deal with 1,250-kilowatt output at the Croydon station. These transformers are placed in twenty-six substations scattered over the district, and the total number of fifty-six of 1,790 kilowatts total capacity is made up of two 100 kilowatts, nineteen of fifty kilowatts, twenty-six of twenty kilowatts, three of twenty-seven kilowatts and six smaller sizes. These are all in use at times of full load, and the number does not include spares. The loss is cut down as far as possible by switching off transformers not required for load. An attendant frequently visits the substation for this purpose.

TABLE V.—TRANSFORMER LOSSES.

	Kilowatts.
Maximum load supplied	1,250
Maximum transformer kilowatts in use	1,790
Minimum transformer kilowatts in use.	920

	Units per Annum.
(*a*) Total losses during time of heavy load	88,800
(*b*) Total losses during time of light load	31,200
(*c*) Total loss during day load	53,200
Total losses per annum	173,200

	June Quarter.	September and March Quarters.	December Quarter.
NOTE—Period (*a*) is as follows	8 P.M. to 12 mid'ht	5 P.M. to 12 mid'ht	2.30 P.M. to 12 mid'ht
Period (*b*) is as follows	12 mid'ht to 3 A.M.	12 mid'ht to 5 A.M.	12 mid'ht to 2.30 P.M.
Period (*c*) is as follows	3 A.M. to 8 P.M.	5 A.M. to 5 P.M.	....

Notwithstanding this method of securing economical working, the aggregate losses are very large. If all the transformers were kept on continually, the additional core losses would amount to 40,000 units at least per annum. As an attendant must, in any case, visit the substation, the saving by this method of working is very considerable.

The losses given in the table are as nearly as possible the average losses in ordinary working. The core loss in a particular 100-kilowatt transformer, however, was 979 watts as minimum, with an applied voltage wave shown on curve 19B, and 1,078 watts as maximum, with a wave as shown on curve 8 C. As this difference is so considerable, it was of interest to investigate the variations of wave-form occurring in ordinary working throughout the twenty-four hours.

The curves obtained serve to emphasize what is often not fully realized—namely, that the wave-form obtained from any given alternator is almost as largely dependent on the kind of load it is called upon to carry as upon the design of the alternator. The curves were traced on a Duddell's oscillograph, and the main connections made to obtain them were as shown in diagram 6, and were such as not

[1] Abstract of a paper read before the British Institution of Electrical Engineers, March 12, 1903.

[1] The thickness of the dielectric between conductors of cables No. 7, 10, 11 and 13 is 0.28 inch. The thickness over the outer is 0.10 inch, except for No. 7, in which it is 0.25 inch. The iron trough in which the cables are laid is approximately 3¼ inches by 3¼ inches outside and ¼ inch thick. Cable No. 4 is armored with steel tape, but the thickness is only about $\frac{1}{32}$ inch, and the outer and inner conductors are of the same section. The capacity of the vulcanized bitumen insulated cable is abnormally high, being over three times that of a similar paper cable.

to alter the normal running conditions to any appreciable extent.

LB is the live bus-bar and EB the earthed bar, the system of supply being 2,000 volts with one pole earthed. D_1, D_2, D_3 are the alternators; F_1, F_2, F_3 are the feeders; R_1 is a non-inductive shunt carrying the whole current, and R_3 and R_4 are non-inductive resistances used as a potential divider to reduce the voltage from 2,000 across the bus-bars to the necessary two volts on the oscillograph; it consisted of a bank of lamps, with a small non-inductive resistance, R_4, in series with it, across which the oscillograph voltage strip was connected; R_1 consisted of brass condenser tubes arranged non-inductively, and tested for absence of self-induction. The height of the current waves was adjusted by altering the value of the shunt, and also by means of an adjustable resistance, R_2, in series with the oscillograph current coil.

The curves were not taken at regular intervals of time, but only when owing to some alteration in the kind of magnitude of the load there was likely to be a change in the shapes of the waves. [The original paper includes three sheets of curves taken under these conditions.] The alternators are all of the iron core, slot wound, revolving armature type, with large percentage regulation. Nos. 1 to 5 were designed to be short-circuited with impunity. They are direct-coupled to their engines and, under normal conditions, run perfectly in parallel at all loads.

On comparing the two sets of curves taken on January 20, 1902, and July 6, 1902, respectively, the first noticeable point is the remarkably peaked waves in the latter. The only difference was the addition of a feeder working at 5,000 volts and 3.6 miles long, a few other 2,000-volt and 200-volt cable extensions, and also No. 6 alternator. The effect of this increased capacity is to totally alter the shape of the current waves and to appreciably alter the voltage wave. It is interesting to notice how, with the load consisting chiefly of cables, the current is leading. As the load increases, the current and voltage waves approach each other in phase and the irregularities are smoothed out. Late at night when the load is mostly arc-lighting, the current lags.

METER LOSSES.

There are in use in the district being considered rather more than 1,200 meters, and the same number of Wright's demand indicators. About 1,000 of these meters are Thomson meters, and the rest of the Westinghouse company's manufacture. The shunt losses are by far the most serious, as these go on continuously, and they amount to a total of 37,400 units per annum.

As is well known, the shunt loss of a Thomson meter is rather high; the Westinghouse meter, however, only takes about one watt in the shunt. The series coil losses, worked out from the load curves for private lighting, only reach a total of 1,350 units per annum for both meters and demand indicators. This low figure is due to the short hours the meters have any appreciable load on them, and to the fact that in the majority of cases the meter is never run at its rated full load. In fact, the total amperage of meters installed is about 3.6 times the maximum current used for private lighting.

It is evident that a large economy could

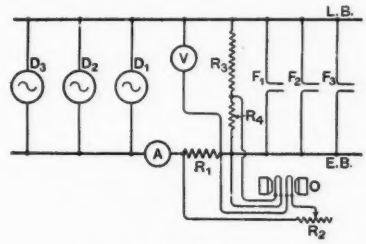
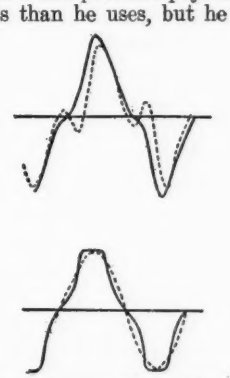


DIAGRAM 6.

be effected by abolishing the shunts altogether and using ampere-hour meters. The only difficulty is the variation of the consumers' pressure from the supply standard. In very few cases, however, is the variation more than the limit of inaccuracy allowed in the meters, and on the average the standard pressure will be very nearly kept to.

Using an energy meter, the consumer who gets a good pressure pays a little more for his ampere-hours than he otherwise would, and is well satisfied. In the case of an ampere-hour meter, the consumer with a bad pressure pays for rather more units than he uses, but he will not



CURVES SHOWING WAVE-FORM OF ALTERNATORS.

notice the difference in his bill, and he will complain of the bad light in any case. There are further advantages in using ampere-hour meters,—*viz.*, cheapness, ease of installing and less risk of breakdown.

The large loss in the shunts given above is due, of course, to the particular type of meter in use, but the Thomson meter is not the worst in this respect, though it is far from being the best.

(To be concluded.)

The Iowa Electrical Association.

The annual convention of the Iowa Electrical Association was held at Davenport, Iowa, April 8 and 9. The first session was held Wednesday morning, April 8, President W. J. Greene, of Cedar Rapids, calling the meeting to order. Secretary W. S. Porter, of Eldora, read the minutes of the last meeting and of the executive committee meeting, and then President Greene made a short address on the objects and interests of the association. About thirty Iowa central station companies were represented, and it was President Greene's idea that the membership should include not less than one hundred central station companies.

The report of the treasurer, George S. Carson, of Iowa City, showed a balance of $169.20, the receipts during the year amounting to $6,429.40.

A report on the price received for street arc lighting by various companies in the state was made by W. S. Porter, of the Eldora Electric Lighting Company. Particulars had been received from seventy-seven companies in Iowa, and a table had been made up showing the price received for street lighting, reduced to a kilowatt-hour basis; the cost of fuel and kind; number of hours; term of contract; number of hours lamps were in service; kind and capacity of lamps used and price per month. The price paid for coal per ton varies from $1 to $3.50, and figured on a kilowatt-hour basis, the lowest price for street arc lighting is 0.033 per kilowatt-hour, and the highest, 0.177. A discussion on the report on street lighting data took place during the Wednesday afternoon session, and Mr. George S. Carson read a paper on "The Maintenance and Operation of a Central Station Using Water Power," giving a brief description of the plant of the Iowa City Electric Light Company, on the Iowa River.

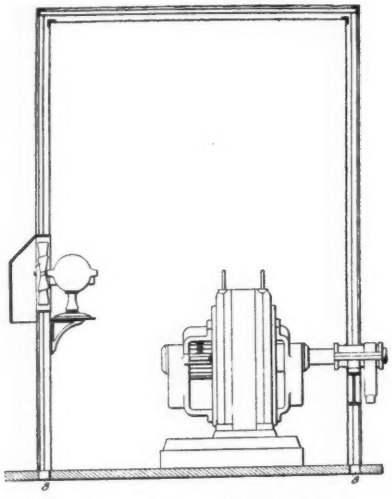
The first paper of the Thursday morning session was by D. F. McGee, making a report on "Data on City Pumping." Following this, Mr. George S. Carson made a report on the subject of lamp testing. Mr. Austin Burt gave a brief description on the Waterloo & Cedar Falls Gas and Electric Company, which was followed with a paper by President J. W. Greene, on "The Necessity of Grounding Secondary Circuits."

Officers for the ensuing year were elected as follows: D. F. McGee, Red Oak, president; W. L. Bowers, Davenport, vice-president; W. S. Porter, Eldora, secretary; Rufus E. Lee, Clarinda, treasurer. Executive committee: Austin Burt, Cedar Falls; George S. Carson, Iowa City; N. J. Higley, Burlington, together with the officers.

The next meeting will be held in April, 1904, at Des Moines.

Electrical Patents.

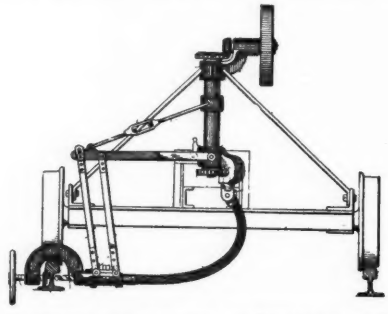
In the operation of electric motors of various sorts in atmospheres which are heavily charged with dust, as in cement-grinding establishments, flour mills and the like, great care has to be exercised to protect the bearings and moving parts from the effect of the dust, and particularly when the latter is of a hard, gritty nature. This has been generally accomplished by the use of so-called "dustproof" motors, but these are unsatisfactory and in time become seriously impaired, besides being relatively expensive. Futhermore, the closing in of the armature, commutator, and brushes, to make them dustproof, interferes with the proper and desirable ventilation of the motors, which therefore become objectionably heated, and, hence, operate inefficiently. The inventor alleges that so-called "dustproof" motors have only about one-half the efficiency per unit of weight of a properly designed open or non-dustproof motor. Mr. Thomas A. Edison has designed an invention which will permit the use of electric motors of the open type in atmospheres, however heavily they may be charged with dust, with the best efficiency at all times and with the complete exclusion of dust from all moving parts. To this end the invention consists in protecting the entire motor with a light casing formed for the most part of a porous textile material so as to act



PROTECTIVE APPARATUS FOR MOTORS.

practically as a dust sieve, permitting the passage of air through its meshes but excluding dust. This casing is preferably constructed with double walls which are spaced apart and entirely enclose the motor. Furthermore, the chamber or casing is provided with an outlet in which is placed an electric motor fan blowing air out of the chamber, such air being received through the textile walls and thereby freed from dust. In actual practice, Mr. Edison has secured excellent results with a five-horse-power electric motor by enclosing it in a casing four feet wide, four feet long and six feet high on its interior, the outer wall being spaced two inches all around from the inner wall.

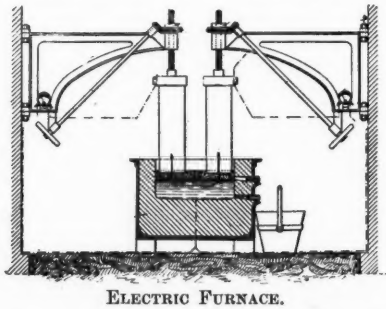
Mr. Henry Gosling, of Cleveland, Ohio, has patented a novel machine for drilling holes in rails. It is intended more particularly for tapping or drilling the



APPARATUS FOR TAPPING OR DRILLING RAILS.

necessary bonding holes for electrical purposes in the ends of rails, as they are found in permanent position on the track for use. The invention comprises a suitable car or vehicle adapted to run upon the track and to be propelled in any suitable manner. All the operating parts are mounted upon the car, including an engine or motor for driving the mechanism. Such motor is attached to a vertical shaft journaled in a frame and arranged above the platforms of the car, the lower end of the shaft having a gear wheel that meshes with other similar wheels attached to the upper ends of a pair of flexible shafts. Mounted upon the supporting frame are vertical swinging arms that are adjustable by means of a turn-buckle. The outer ends of these arms carry depending links from which is suspended a horizontal channel bar, and fastened to the channel bar are transversely disposed boxes in which are journaled the drill holders that are attached to the flexible shafts. A yoke is also pivoted upon the channel bar and is arranged to embrace the rail, the free end of the yoke having a clamping screw which permits the drills being drawn tightly against the inner face of the rail. In use, the yoke is placed astride the track and the drills are placed in proper position at the adjacent ends of the rails. Thus, when the mechanism is operated, said drills will be driven and are held to their work by the clamping or feed screw of the yoke.

A Frenchman, Paul Louis Toussaint Héroult by name, residing in La Praz, Savoie, France, has patented an electric furnace, which he has assigned to Sté Electro Metallurgique Française, of Froges, Isère, France. The improvements to which this invention relates have been devised in order to obtain by the electric furnace soft metals, such as chromium, manganese or iron, and, generally, substances which tend to combine with carbon. In order to avoid as much as possible all possible introduction into the material operated on of carbon from the electrodes instead of the single arc which usually heats an electric furnace, two separate arcs in series are, according to this invention, employed to play through the insulating layer of slag between the metal or the fused conducting material on the one hand and the two electrodes on the other hand. In order to ensure the distinct formation of these two arcs, two accessory circuits are arranged, connecting outside the furnace each of the two electrodes to the fused materials, and in each of these circuits there is introduced in shunt a voltmeter, the indications of which serve to verify constantly and regulate the position of both electrodes and to determine whether or not the furnace is operating properly. Thus either by hand or by automatic mechanism operated by the two shunt currents each electrode can be raised or lowered to determine the arc, as desired. The out-

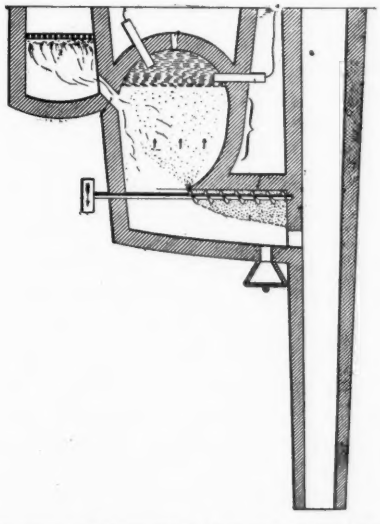


ELECTRIC FURNACE.

going conductor consists of a rod passing through the crucible wall and projecting outside and inside of the same, so that the portion of the rod which is melted is replaced by molten material which fills up the space and ensures good conductivity. When alternating currents are employed and the electrodes are arranged so as to consume equally, the position of both can be regulated at the same time by employing a single voltmeter between one of the electrodes and the metal.

A new process of reducing iron from its ore by the aid of electricity has been patented by Mr. Marcus Ruthenburg, of Philadelphia, Pa. The process consists

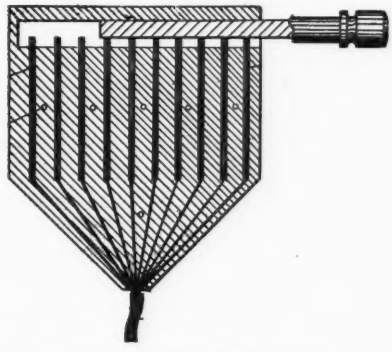
in preheating a mass of comminuted ore, introducing the heated ore to an atmosphere of deoxidizing gas, such as hydrogen or hydrocarbon gas, arranged to reduce the particles of ore to the metallic state without fusing them, and finally fusing the metal residue. A furnace is employed comprising a crucible in which are opposed electrodes of the heating circuit. Above this crucible, and in communication therewith, is a hearth enclosed by a flue leading from the crucible to the stack. A hopper is arranged to deliver material upon the hearth and a screw shaft is so constructed as to deliver the material from the hearth to the crucible. A mass of comminuted ore being delivered upon the hearth through the hopper is preheated on such hearth to such a degree that a deoxidizing gas will immediately reduce it in its comminuted state and in such preheated condition this comminuted ore is gradually introduced to the crucible, which contains the atmosphere of heated deoxidizing gas. The furnace is so proportioned and arranged that the particles of comminuted ore are reduced in passing from the top to the bottom of the crucible, through this atmosphere which is arranged in an intermediate zone. Below the zone the heat causes the fusion of the reduced particles which fall into a molten metallic residue. The atmosphere is conveniently maintained in the crucible by combustion of fuel in a fire box located at one side of the same, the products of such combustion being delivered to the crucible through a suitable flue. However, the principal



PROCESS OF REDUCING IRON FROM ITS ORE.

source of heat in the furnace is the electric current which passes between the electrodes, above described, and fuses the interposed mass, which mass forms a conductor for it. The inventor prefers an electric current as a source of heat in the conduct of his process, for the reason that it may be precisely varied at the will of the operator with consequent variance in the product. For instance, the oxide may be reduced at a temperature less than that which the carbon will combine therewith in the production of carbide and thus malleable iron may be directly produced, or by elevating the temperature various grades of steel may be directly produced, the percentage of iron introduced to the product being, of course, predetermined by the temperature at which reduction is effected.

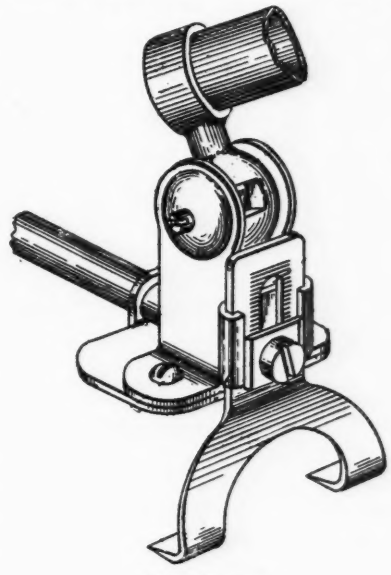
A unique and simple electric current controller has recently been patented by Mr. James J. Murphy, of Jersey City, N. J. A body of insulating material is employed which comprises an intermediate section and two face sections, applied to opposite sides of the same. Grooves are formed in the coacting faces of the sections to receive spaced sets of conducting wires which converge at the lower end



ELECTRIC CURRENT CONTROLLER.

of the body, where they are attached to suitable cables. This lower end is tapered while the upper end is enlarged to form a transverse socket into which the sets of conducting wires project. A contact device in the form of a rod is slidably mounted in the socket having on its outer end a suitable handle, and arranged to engage the projecting ends of the wire. The amount of current passing through the device can be controlled by moving the rod or plug into engagement with more or less of the contacts as desired.

A novel desk clamp has been patented by Mr. Alan R. Fergusson, of Mount Vernon, N. Y., who has assigned his entire right to the Electro-Mechanical Specialty Company, of New York city. A tubular clamping member is employed, one end of which is bent to form a hook, the other end having internal screw threads. Upon this member is slidably mounted another tubular section having on its free end a vertically adjustable hook provided with a longtitudinal slot. Through this hook and outer tubular member is passed a screw that is threaded into the first-mentioned member. A suitable supporting ear is also employed



DESK CLAMPS.

and is located adjacent to the screw, this ear carrying a bracket for supporting an electrical instrument or lamp. By this arrangement a single screw is employed which holds all of the parts in adjusted position and permits that attachment of the clamp to the top of any ordinary desk.

Conigrams.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I suggest we use the last part of Marconi's name for the new messages, and the three systems to be thus known: Telegrams, cablegrams and conigrams.

JOHN HORN.

Montreal, April 6.

[This term was suggested by Mr. Jarvis B. Edson, of New York city, under date of December 27, 1901.—ED.]

Non-Interfering Wireless Telegraphy.

In his last Cantor lecture Dr. J. A. Fleming dealt with the question of the interception of messages, and recounted the results which he had obtained recently at Poldhu. Two series of messages were sent from Poldhu—one from the large aerial used in transatlantic signaling, and the other from a small mast used for short-distance experimental work. All of the messages were secret, being known only to Doctor Fleming. Some of them were in cipher. They were transmitted simultaneously and received at the Lizard, where there were two receiving stations, one tuned to the large, and the other to the small aerial. The messages were sorted out perfectly and printed on Morse tapes.

Reviews of Current Engineering and Scientific Literature.

A Celluloid Insulator.

In a note appended to a very detailed description of the Basanta system for communicating with and signaling to railway trains is given a description of a celluloid insulator which is used in Spain. A test of this insulator conducted by the officers of the Spanish telegraph system, showed the following results: It was plunged in water for twelve hours, almost completely submerged, with the inverted petticoats nearly filled with water. Measurements in this condition showed a practically infinite resistance. Soaking in water for twenty-seven hours showed no gain whatever in weight, indicating no absorption of moisture. Raising it to sixty-five degrees centigrade did not change its form. Maintaining it for three hours in a current of air, at a temperature of seventy degrees centigrade, and then putting it under strain, with a wire three millimetres in diameter, did not affect any mechanical deformation. Submitting it to severe mechanical shocks did not injure it, as the material is quite elastic. Two types of insulator are shown—one ninety millimetres in height, having three petticoats, and the other eighty millimetres high, with but two petticoats. The latter weighs about ninety-seven grammes, and is said to cost about two francs (forty cents). The following summary of the advantages of this insulator is given: Its insulating property is as good as that of porcelain, it is lighter than porcelain, and hence allows quicker work in erecting lines and less strain to cross-arms; it is impermeable, and is not affected by insects. It is soft, and can be moulded to any shape, and no packing is needed between the insulator and the pin.—*Translated and abstracted from the Revue Technologique (Paris), March 20.*

Measurement of High Temperatures.

Mr. Sidney Weiss in this communication gives an account of his experiments with pyrometers. He has used two constantly for some years at the blasting furnaces in South Russia. The Roberts-Austin is of a photographic recording type, and is used in regulating the temperature of the hot air mains. The couples last almost indefinitely if undisturbed, but in practice a new twist is made about every three months, so as to renew it. With this instrument temperatures may be read to within ten degrees Fahrenheit. The instrument is very satisfactory, but is nonportable. The couples are made of platinum, and platinum plus ten per cent of iridium. The wires become somewhat brittle after a time. The Le Chatelier instrument is small, portable, and very sensitive, and is adapted for use on iron and steel works. Temperatures up to 1,600 degrees centigrade, by divisions of twenty degrees, may be read, and it is easy to read within five degrees very nearly the whole scale, which is very uniform after 300 degrees. In both instruments D'Arsonval galvanometers are used. For the latter pyrometer the galvanometer is portable, connection being made to the movable coil by means of flat spiral wires. The same couple is used as in the first. This instrument has been used chiefly for experiments in annealing steel, for checking temperatures in the reheating furnaces at rolling mills. It has also been used to take casting temperatures of iron and steel. This is not easy, on account of the corrosive action of the metal on the pyrometer tube. This instrument has also been used in the chemical laboratory for experiments on the recalescence in iron and steel.—*Abstracted from the Electrical Review (London), April 3.*

On the Heat Developed Spontaneously by the Salts of Radium.

In studying the salts of radium, MM. P. Curie and Laborde have found that they give out heat in a continuous manner. The experiments were carried out by surrounding two thermoelectric couples of iron and constantan, one by radioactive barium chloride and the other by pure barium chloride. The bulbs containing these salts were of the same size, in one of which was placed one gramme of radiferous barium chloride containing about one-sixteenth of its weight of radium chloride, the other containing one gramme of pure barium chloride. The junctions of the thermoelectric couples were placed one in each bulb among the matter contained in them. The bulbs were isolated in air in the centre of two small identical enclosures surrounded in turn by a third which was thermally insulated and maintained at a practically uniform temperature. Under these conditions the variations of the surrounding atmosphere were felt in the same manner at both junctions and did not influence the indications of the couples. A difference of temperature of 1.5 degrees was observed, the radiferous salt having the higher temperature. As a check, the experiment was repeated, but with both bulbs filled with pure barium chloride, when the difference in temperature was only 0.01 degree. To estimate quantitatively the heat disengaged in a given time by the radium, a bulb containing radium was enclosed in a block of metal. One of the thermoelectric couples was placed in a cavity in the block and the other in the second block containing no radium. When conditions of equilibrium had been established the two couples indicated a certain difference of temperature between the two blocks. Then a bulb containing a fine iridium wire replaced that containing the radium. An electric current was passed through this wire until the same difference of temperature was indicated by the thermoelectric couples, and the energy radiated by the wire was calculated. It was found that the gramme of radium disengaged about fourteen small calories per hour. The exact composition of the material was not known, but judging from its radioactivity it contained about one-sixteenth of its weight of pure radium chloride. Experiments were also made with 0.08 gramme of pure radium chloride, and both results were of the same order of magnitude, but not in perfect agreement. These experiments indicated that one gramme of radium disengages an amount of heat which is of the order of 100 grammes calories per hour, one gramme atom of radium (225 grammes) would disengage during every hour 22,500 calories, a number which is comparable to the heat produced by the combustion in oxygen of one gramme of hydrogen. The continuous development of such an amount of heat can not be explained by an ordinary chemical transformation. If it be due to a molecular modification of the radium atom itself, such transformation must go on with extreme slowness, as the properties of radium do not undergo any notable variation during several years. It is suggested that this disengagement of heat may also

be explained by supposing that radium utilizes an external energy of an unknown nature.—*Abstracted from the Electrician (London), April 3.*

Arc Light Carbons for Intense Light.

This article by Herr Otto Bögel, discusses the use of impregnated carbons for intense illumination. In manufacturing these carbons it is necessary to distinguish between the binding material, the illuminating material, which determines the color and intensity of the light, and the flux. Contrary to the general belief, the effect of the material added to increase the intensity of the light is not great, and the greater part of the light given off is due to the burning of the carbon itself. The action of the arc is to convert the carbon into graphite, and the temperature of the arc depends upon the degree to which this has been carried. To secure the best results great pressure should be used, so as to secure a dense carbon. The author's work indicates that more attention should be paid to this point. The effects of the various materials used to enrich the effects of the light are then discussed. The aim should be to obtain a light similar to sunlight, and as each material gives a distinctive color, they should be so combined as to produce a white light. By mixing materials which give complementary colors, a dirty white only is obtained. These mixtures should contain only materials which have approximately the same melting points. A good deal of experimental work has been done by the author in studying the effects of these materials. It was found that while sodium always gives a distinctive yellow color, the quality of this yellow varies according to the compound of sodium which is used. These compounds should not be affected by air or moisture. In preparing them it is essential to draw off all water of crystallization, and to ensure this, the material should be melted down. With enriched carbons it was found that a steady, quiet arc could be maintained with a pressure of only twenty-eight volts and two and one-half amperes. A table is given showing the results of various sodium compounds used in enriching the carbon. This shows the compound and its physical characteristics, the length of arc, the color of the light, its intensity, and its quality.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), March 22 and 26.*

Ruhmkorff Coils and High-Speed Interrupters.

The Ruhmkorff coil is simply a special type of transformer, and the instantaneous values of the secondary are proportional to the product of the ratio of transformation and the instantaneous pressure on the primary. The exact quality is not obtained, on account of the iron losses of the core. Though the effective values of both the primary and secondary are small, the maximum values may be considerable. To secure the most efficient operation, the primary current should be broken as soon as it reaches its maximum value. This break must be quick to give a high voltage in the secondary. The effect of rapid breaks has been discussed by Lord Rayleigh, who first used a simple mechanical interrupter, then modified this so that it was opened by a sudden blow, and again so that the circuit was opened by a rifle ball. The more rapid the break, the higher the secondary voltage. A table is given showing the number of turns, and the maximum primary and secondary voltages of a series of induction coils made by J. Carpentier & Company, the length of spark varying from fifteen to sixty centimetres. Three rapid interrupters are then described. The first is the Carpentier, in which a vibrator, operated by a local circuit, is attracted by the iron core, and in its motion strikes a second vibrator, opening the circuit between the latter and its stop. The vibrator is small, and moves upon a knife edge. It is so constructed as not to move harmonically. Another new interrupter, the Chauvin & Guere, has already been described in the ELECTRICAL REVIEW. In this the circuit is broken between two springs, one of which is attracted by a small electromagnet excited by the current. As it moves, the second spring follows it, and it attains a certain speed before the break occurs. The third interrupter is designed by Mamy. In this a balanced lever is held against a stop by a steel spring. The latter is attracted by the core of the magnet, and a second spring causes the lever to follow it. The motion of the lever is limited by a stop. The break is sudden, and occurs after a certain speed has been acquired. These interrupters not only increase the effect of the coil, but allow it to discharge at a rapid rate, permitting it to be used with high-speed gas engines.—*Translated and abstracted from l'Électricien (Paris), April 4.*

The Daft and Williams Electrical Prospecting System.

This method of prospecting for ores was described in the ELECTRICAL REVIEW March 14 and April 11. This article gives an account of a recent test carried out at the Telacre mine, near Prestatyn, in North Wales. This lead mine has never been a paying one. During the last four years about twelve tons of lead have been obtained, but the lode instead of getting richer has become poorer, so that working has been abandoned. The question to be determined was whether the extended lode which has not been opened up was more highly mineralized or if the lode would be more valuable if developed at a greater depth. The lode as proved, extended in a straight line and it was believed that it continued in this direction. Explorations could be made by inserting electrodes at the surface of the ground or within the workings. Two exciting electrodes were set 110 yards apart at equal distances from the lode and so that the line joining them would be normal to the direction of the lode. The field to one side of the lode was then explored by means of a telephone connected to two earthing spikes which were moved around and shifted until the lines of current flow had been determined. It was expected by the local mining experts that the lode would continue in a straight line but it was indicated from this survey that it lay considerably to one side of its supposed position. During this work it was shown that conductors lying on the surface of the ground, such as a wire fence, did not interfere with the working of the apparatus. A test was made to determine if more lead could be found by following the lode down. The results indicated that this would be the case, but at present it is impossible to predict whether the large amount of lead ore as indicated by this system exists in a sufficiently concentrated condition to make it workable, or whether an equal quantity of lead is distributed so as to make it commercially worthless. In this mine the ordinary means of searching for lead have exhausted the shareholder's money and faith. The electrical prospecting indicates which way future developments might strike richer ground, and it is hoped that these indications will be proved by mining, as was done in the Cwmystwyth mine.—*Abstracted from the Electrical Engineer (London), April 3.*

To secure uniform temper in working parts of machine drills, the various pieces, nuts, bolts and moving parts of the drill, are carefully packed in boneash in a steel box, a cover luted on, and the whole placed in a furnace, where it is heated to a bright red. The box is then removed from the furnace, the cover taken off, and the several pieces of steel thrown into a tank of cold water as quickly as they can be removed from the boneash. This gives the entire lot the same temper, securing the much desired hardness and uniformity of texture.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

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George Ashley Campbell, Newtonville, Mass.
Paul Griswold Chace, Chicago, Ill.
William M. Case, Clarksville, Tenn.
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Alexander Churchward, Pelham, N. Y.
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John Hays Smith, Pittsburg, Pa.
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Pliny P. Spaulding, Schenectady, N. Y.
Severn D. Sprong, Brooklyn, N. Y.
Numa Reid Stansel, Portsmouth, Va.
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Edgar Strasburger, New York city.
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Silas Taber, Auburn, N. Y.
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TRANSFERRED FROM ASSOCIATE TO FULL MEMBERSHIP.

B. V. Swenson, Madison, Wis.
James Swinburne, London, England.

Canadian Electrical Association.

The annual convention of the Canadian Electrical Association will be held this year in Toronto, on Wednesday, Thursday and Friday, June 10, 11 and 12. The local committee consists of all the members of the association residing in Toronto, with Mr. J. J. Wright as convener. P. G. Gossler, of Montreal; A. A. Dion, of Ottawa, and J. J. Wright, of Toronto, compose a committee to award prizes for papers of superior merit. This convention is expected to be one of the most popular and also productive of the best results of any which has heretofore been held.

BOOK REVIEW.

"Der Dreistrommotor als Eisenbahnmotor." (The Three-Phase Motor for Railways.) Wilhelm Kübler. Leipsic. Verlag von Arthur Felix. Paper. 104 pages. 6¾ by 10½ inches. Numerous diagrams and charts. Supplied by the ELECTRICAL REVIEW at $2.00.

This book gives a critical study of the induction motor as applied to railway work. The general character of the work required of railway motors is first considered, and then the effects of various methods of construction and operation upon the induction motor as affecting its suitability for this service. Two typical European installations are here discussed in detail—that of the Burgdorf-Thun Road, and that of the Marienfeld-Zossen high-speed road—and the construction methods fully illustrated, curves being given showing the performance of the motors. The book gives an excellent review of European experience in the application of induction motors to railway work.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Double Battery.

A semi-dry cell and battery is being placed on the market by the Hydra Battery Company, 70 and 72 Reade street, New York city, which the manufacturer claims possesses some important features. These cells are manufactured under a special process, employing a highly porous carbon which is filled with a special depolarizer and sealed at the top with pitch. The carbon is encircled with an outer depolarizer enclosed in a network of linen. These elements are then

AUTOMOBILE BATTERY.

placed in a zinc cylinder cup, after being insulated by glass tubes. A specially prepared wet electrolyte is then poured in between the outer depolarizer and the cup, the combined elements being sealed at the top with paraffin. The cell is then encased in a specially prepared insulated paper, and placed in a metal case which is not part of the element, and sealed at the top with pitch. When completed, the cell gives a double-insulated double-sealed battery, and the claim is

"HYDRA" TELEPHONE BATTERIES.

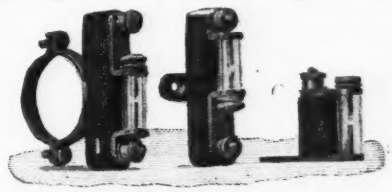
made that the current is very strong, and the life of the battery very high. These batteries are especially useful for users of automobiles and gasoline launches.

The Berlin Automobile Exposition.

The National German Automobile Exposition was opened at the Flora Garden in Charlottenburg, on March 8, and ran for about two weeks. It was in every respect the most interesting, popular and successful exhibition of the kind ever held in Germany. The exposition was the joint enterprise of a union of German motor carriage builders and the German Automobile Club. This is a national organization made up of seventeen clubs, located at Strasburg, Bielefeld, Munich, Coblenz, Dresden, Frankfort, Nuremburg, Halle, Hanover, Cologne, Leipzig, Eisenach, Mannheim, Breslau, Aix-la-Chapelle, and two clubs at Berlin. These include among the members substantially all the Germans who are interested in automobilism for purposes of sport and recreation. The union of German motor carriage builders includes principally the Daimler Company, of Cannstadt and Marienfelde, builder of the "Mercedes" racing machine; Benz & Company, of Mannheim; the Dürkopp Company, of Bielefeld; Adam Apel, of Russelsheim, and the Adler Company, of Frankfort—all bicycle makers who have taken over their extensive works into the manufacture of motor carriages; the Cudell Company, of Aix-la-Chapelle; Dietrich & Company, of Niederbraun; Weiss & Company, of Berlin; the Bergmann Company, of Gaggenau, and a dozen others, besides a large number of makers of pneumatic and other tires, wheels, igniters, and all the various details of motor vehicle construction. The exhibitors numbered this year about 115. Two American machines—the Oldsmobile and the Locomobile—were exhibited by the German firms at Hamburg and Berlin, respectively, which have, within the last three months, taken over the general agency for this type of vehicle. In the same way, the French Dion-Bouton carriages were exhibited by the Berlin agents.

External Spark-Gaps.

For some time a great difficulty was experienced by users of gasoline or other internal combustion engines which employed an electric ignition device, by the accumulation of sooty particles on the spark contacts. Application has recently been made of a device by which an additional spark-gap is introduced in the high-tension circuit, and a number of novelties have been placed on the market to carry out this idea. Messrs. Peto & Radford, Limited, of 57B Hatton Garden, E. C., London, England, have recently placed on the market an outside ignition sparking device, which is shown in the accompanying illustration. This is made in the three forms shown herewith, the one on the left being intended for use on the top bar of a motor-cycle. In each case the spark-gap is protected by a glass tube, and the length of the



EXTERNAL SPARK-GAPS.

spark may be accurately adjusted by one of the screws which is fitted with a lock-nut. These devices are well made, and are mounted on ebonite blocks.

Electrical Instruction for Army Officers at Sandy Hook.

As an aid in the instruction of officers of the army in electricity and electrical apparatus, the government has recently ordered from the Westinghouse Electric and Manufacturing Company a thirty-kilowatt, alternating-current, composite-wound, belt-driven generator, delivering two-phase current at 220 volts and 7,200 alternations, running at 1,200 revolutions per minute; a one and one-half kilowatt, direct-current, direct-coupled, compound-wound, multipolar exciter of 125 volts and 1,300 revolutions per minute; and a one-horse-power, single-phase, alternating-current motor of 200 volts, 7,200 alternations and running at 1,600 revolutions per minute, together with starting rheostat and other auxiliary apparatus. There is also being supplied a ten-kilowatt rotary converter, two and three-phase, 220 volts, alternating current, 7,200 alternations and 1,800 revolutions per minute. This rotary converter is provided with an extended shaft for operation as an alternating-current and as a direct-current generator, together with two autotransformers which provide for the raising of the alternating-current voltage from 175 to 220 volts when the rotary converter is operated from the direct-current side, and a direct-current, 125-volt, compound-wound, multipolar exciter of three-quarters-kilowatt capacity. Added to the above are four seven and one-half kilowatt transformers, 2,200 volts primary and 220 volts secondary, arranged for scrap three-phase two-phase transformation, enabling them to operate on two-phase or three-phase.

These are to be installed on the Sandy Hook Proving Ground, with complete switchboard and detail parts, having recently been accepted by Captain Dunn, U. S. A.

Improvements in the Edison Storage Battery.

Mr. Thomas A. Edison, of Orange, N. J., has secured two patents upon an improved electrode for his storage battery. This improvement relates to storage batteries wherein an alkaline electrode is employed with insoluble active materials. These active materials are supported in position with sheet metal, nickel-plated, perforated and corrugated pockets, crimped in position within openings formed in suitable grids. It has been found in practice that the active material, when immersed in the electrolyte and subjected to a charging current, tends to bulge objectionably at the centre. This is particularly true with a nickel element, the effect being to prevent placing the plates as close together as is desirable. To overcome this difficulty the receptacles are made with concave faces when the electrode is first assembled. The swelling of the active material then does not bulge the electrode objectionably. The receptacle consists of two rectangular dishes fitting one over the other. Into the smaller half is placed a compressed briquette of active material, and then the edges are pressed down over the briquette, holding it securely in place. The whole is then placed within the second half of the receptacle, and its edges also pressed down over the inner half, thus forming a rectangular block of metal, and entirely enclosing the briquette. The blocks are then placed within the grids, and the plate thus built up placed in a press which crimps the metal case of the briquette over the grid, and at the same time gives the former its concave form. The plates thus formed are then placed in a second press, which corrugates the receptacles. In these presses there is one die for each receptacle. They are mounted independently, and are backed up by a layer of rubber or some other suitable yielding but non-compressible material. By passing the plates through two presses, it is said that a better distribution of material is obtained within the receptacle than would be the case if the crimping and corrugating were performed in the same operation. The second patent covers a method of securing better electrical contact between the particles of active material of the iron element in the nickel-iron storage battery. In the early type of cell, flaked graphite was mixed with the finely divided iron to provide a good electrical path. In a later application an easily reducible metal, such as copper, mercury or silver, or compounds thereof, is added to the oxidizable active material. In this patent a combination of mercury and one or more other readily reducible metals, such as copper, is claimed specifically. The inventor found that mercury when employed in connection with copper, possesses an advantage over the use of copper alone when mixed with oxidizable material, as it preserves the surface of the copper from oxidation, and enables the use of flaked graphite to be done away with; and, at the same time, the mercury gives a cell which is capable of sustaining a high voltage throughout the entire period of discharge. To obtain this mixture, to the finely divided iron is added a sufficient quantity of ammoniated copper and a precipitated oxide of mercury, to produce as a final product a mixture composed of sixty-four per cent of iron, thirty per cent of copper and six per cent of mercury. The copper and mercury are immediately reduced to the metallic state by the reaction of the iron, a portion of which becomes oxidized; while, at the same time, particles of metallic copper will be coated with an amalgam of mercury, so as to be preserved better from the effects of oxidation. As a result of this treatment, the exterior of each active iron particle will be coated with a porous envelope of amalgamated copper in an extremely finely divided form, mixed with a small proportion of iron oxide. This mixture is ready for immediate moulding into briquettes. The use of an easily reducible metal like mercury or copper is not regarded as practical in connection with a nickel or other depolarizing electrode of an alkaline storage battery, and the flaked graphite is preferable here.

A recent statement from the Edison laboratory states that a runabout battery can be charged sufficiently in one hour to drive the machine sixty-five miles without injury to the battery. This is at a rate of charge of about eighty per cent in the first hour, rating the battery at eighty miles. The improved performance claimed for the Edison battery may be judged from the performance of a runabout equipment of lead cells. Such an equipment will drive the machine forty miles. It should not be charged at less than a three-hour rate, and, when charged at this rate, can receive fifty per cent of its capacity, or sufficient for a twenty-mile run, in the first hour.

A cubic foot of water contains seven and one-half gallons and weighs sixty-two and one-half pounds. A gallon contains 231 cubic inches and weighs eight and one-third pounds. A cubic foot of sea water weighs 64.31 pounds.

Alternating-Current Long-Scale Voltmeter and Ammeter.

The accompanying illustrations show an improved form of voltmeter and ammeter, possessing a high grade of excellence. These are induction instruments, and in principle of operation are closely allied to the integrating wattmeter made by the same company, the Westinghouse Electric and Manufacturing Company.

ALTERNATING-CURRENT LONG-SCALE AMMETER.

These instruments, simple in design, are made in the pattern shown herewith, and also in the more familiar circular form.

The scales begin at zero, and the divisions are absolutely proportioned and uniform above twenty per cent of the full capacity, with a length allowing the readings to be made with perfect accuracy. As an additional aid to easy and correct reading from a distance the dial is made of translucent material, illuminated from the rear, while the markings are distinct and the figures large and prominent. The lamps for illuminating this scale are enclosed in a compartment separate from the rest of the mechanism, giving perfect ventilation and not heating the working parts.

ALTERNATING-CURRENT LONG-SCALE VOLTMETER.

In this type an electromagnet produces

a shifting magnetic field, in the air-gap of which is an aluminum disc in which currents are induced by the field, resulting in the disc's movement. This motion being opposed by a spring, the amount of deflection is shown by a pointer mounted on the shaft of the disc. When the pointer is at the zero position, the outline of the disc being spiral, the air-gap closes that portion of the disc having the longest radius. As the deflections increase the enclosed radii decrease, diminishing the pull on the disc until it becomes proportional directly to the current, resulting in a uniform scale.

These instruments are absolutely unaffected by external fields, are totally dead-beat, and are compensated for changes in temperature and frequency. The moving elements being very light in weight, the bearings perfect, finely ground jewels and the shaft carefully hardened and polished, render friction a negligible quantity. Made to certified and legal standards, with extremely careful calibration, these instruments claim features of accuracy, permanence, and mechanical excellence. The parts are interchangeable, and the cases dustproof and of neat appearance.

Instead of requiring the main current to be brought to the instrument, necessitating in some cases expensive busbar connections, this make of ammeter is arranged to operate from five-ampere secondaries of series transformers, thus enabling the instrument to be mounted at any convenient point.

Producer-Gas Power Plant for Greece.

The favor in which American power apparatus is held by foreign capitalists, is well illustrated in a recent light and power enterprise for Tripolis, Greece. The high price of coal at this location has induced the promoters to install gas power, with the intention of giving it a thorough trial. The fuel to be used will consist entirely of native lignite, which has been found to yield a gas of good quality, and quite suitable for power work. The plant will have a present capacity of about 125 horse-power and Westinghouse three-cylinder vertical producer-gas engines will be used. There will be two of these engines, each belted to a generator, which will supply the present demand for current. The engines will be supplied with fuel gas from Taylor producers, furnished by R. D. Wood & Company. The installation is a good example of the dependence placed upon American apparatus, and the results obtained from the future operation of this plant will be of much local interest, as indicating the utility of cheap native fuels for power work.

The Duty of a Reheater.

At 100 pounds gauge pressure, steam weighs 0.264 pound per cubic foot. In the case of a duplex, direct-acting, triple-expansion engine, steam, when superheated 125 degrees Fahrenheit, will do sixteen per cent more work than when saturated. With steam so superheated, and the feed water passed through an exhaust heater, a given amount of fuel will produce ten per cent more work. The duty of a reheater is the sum of two distinct actions—the drying of wet steam and superheating of the steam thus dried. For the first, it must be competent to supply the amount of heat per unit weight. The area of heating surface and the temperature-head producing flow into the drying stream, as it passes into and through the reheater, must be sufficient to furnish this amount and also the quantity per unit weight required to ensure the demanded superheat for each unit weight of steam flowing through the reheater. The use of perfectly dry steam and the elimination of condensed water would seem a very practical advantage of superheating. Water is a disturbing element in steam engines and steam pipes at all times.

Core Type Transformers.

The General Electric Company, Schenectady, N. Y., manufactured the shell type of transformers for eight years, from 1888 to 1896, at which time the many advantages afforded by the core type with reference to safety, durability and economy were recognized. The type H transformer was then placed on the market. During this period continuous improvements have been made in all the features that go to make up a good transformer. Some of these are enumerated below.

The great reduction made in losses during the last three years will be appreciated by referring to the accompanying curves; Fig. 1 shows the reduction in core loss, and regulation from 1899 to 1902. On the various sizes the average percentage reduction in core loss is 11.7 per cent and in regulation is eight per cent. Since transformers are usually energized twenty-four hours a day, low core loss is of great importance in its effect on the all-day efficiency. Minimum core loss is one of the leading features of type H transformers.

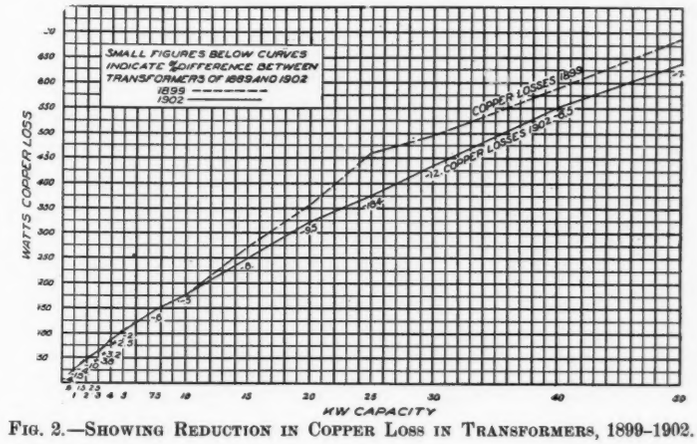


FIG. 2.—SHOWING REDUCTION IN COPPER LOSS IN TRANSFORMERS, 1899–1902.

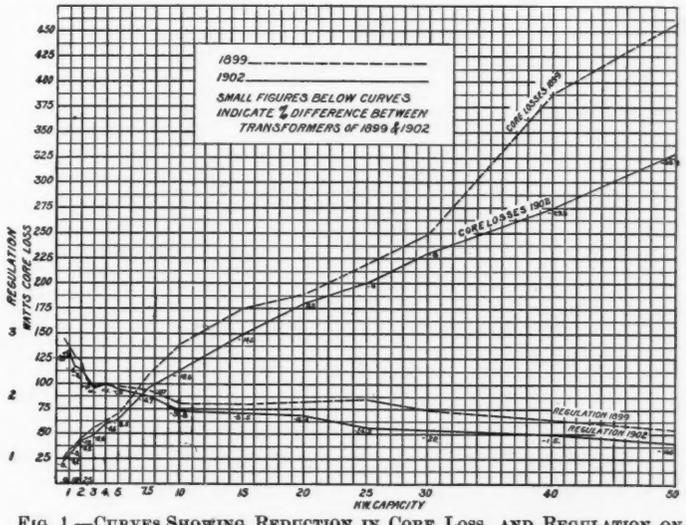


FIG. 1.—CURVES SHOWING REDUCTION IN CORE LOSS, AND REGULATION ON TRANSFORMERS, 1899–1902.

It is essential that the regulation of a transformer be as low as is consistent with good characteristics in other respects, as it admits of the use of high-efficiency lamps, ensures low cost for lamp renewals, and makes possible a small variation in voltage between the peak and light loads on the station and consequent uniform light throughout the twenty-four hours.

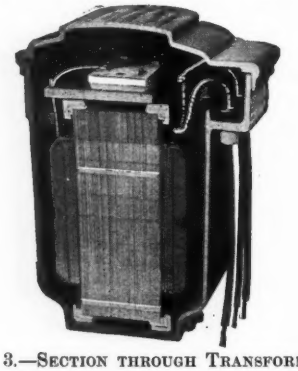


FIG. 3.—SECTION THROUGH TRANSFORMER.

Low uniform temperature is of importance in preserving the insulation and preventing deterioration of the iron which results in increase in core loss, commonly known as aging. The American Institute standard of fifty degrees centigrade as the ultimate temperature rise by electrical apparatus has been adopted, as this is regarded by the most eminent engineers as a good safe figure. The ultimate temperature rise of type H transformers will not exceed this amount, and because of the details of construction the temperatures are uniform throughout. Every part of every coil has practically the same facility for passing off its heat.

Aging has been reduced to a minimum by the use of specially treated sheet steel and by processes of manufacture which have been developed in the course of fifteen years' experience. Among the aids in regulating the properties of steel may be mentioned the microscopic examination of sample steel. (A characteristic photomicrograph is shown in Fig. 6.)

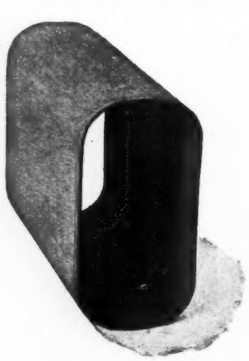


FIG. 4.—INSULATION BETWEEN PRIMARY AND SECONDARY WINDINGS.

This method of investigation requires skillful experts and a high grade of technical knowledge; but no expense has been spared to secure the best results. The effect of this work is shown by the result of a test which was made on forty-three type H transformers taken indiscriminately from the lines of central stations. These were returned to the factory and were carefully retested to show the amount of aging during their periods of operation. These transformers had been in service on an average for two and one-half years, and showed an average of 3.1 per cent.

Every transformer, before shipment, receives careful tests as to its characteristics. An accurate record is kept of all these tests, so that at any time they can be readily compared with the result of subsequent tests.

FIG. 5.—SHOWING SPACE LEFT FOR THE CIRCULATION OF THE OIL.

Careful attention is paid to the insulation which is used in these transformers. The method of manufacture of the various insulations used and methods of inspection employed, combined with the low uniform temperature maintained, have met with such success that during the last three years less than one-third of one per cent of the total capacity of transformers sold have burned out from all causes, including lightning and overload. The percentage of burnouts due to lightning alone is two-tenths of one per cent. In this connection, particular attention is called to the mica insulation shield shown in the accompanying illustration (Fig. 4), which is placed between the primary and secondary coils and renders a cross between primary and secondary practically impossible.

The value of oil as a cooling and insulating medium has long been recognized, but this value is greatly reduced unless oil of the best properties electrically is used. Although the oil used in type H transformers, which is made especially for the purpose, has very high insulating qualities and is remarkable for its non-absorbent properties, it is subjected to very rigid inspection as to its characteristics, for the presence of moisture, and unless it passes this test satisfactorily, is rejected. The result is oil which gives the best results, both as to cooling and insulation.

Fig. 5 shows clearly spaces which are left for the circulation of oil in sizes of transformers constructed with cruciform cores.

Type H transformers are made in sixteen sizes, from 600-watt to 50,000-watt, inclusive, and in two lines, which, for convenience, are termed the high and low-frequency lines of type H transformers. Both of these lines of transformers have the well-known characteristics of the type H design, and the maker states both will give perfectly satisfactory operation on either 60 or 125 cycles. The distinctive difference between the two lines of transformers from an operating standpoint is in their data, the high-frequency transformers being slightly less efficient than the low-frequency, and having a correspondingly lower cost. For sixty-cycle operation the high-frequency line may be used when extremely low efficiency is not of great importance. The transformers made for three-wire service have the winding so distributed that the voltage on the two sides of a three-wire system will not differ more than the regulation drop of the transformer, even with one-half the rated capacity of the transformers all on one side; with ordinary distribution of load the voltage will be practically equal on the two sides.

FIG. 6.—PHOTOMICROGRAPH OF SPECIAL ALLOY STEEL.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW YORK STEAM ROAD MAY CONVERT ITS SYSTEM—It has been reported in New Haven, Ct., that the New York, New Haven & Hartford Railroad Company will convert its Harlem River branch into a high-power electric passenger line, and by connecting it with its trolley system running west from Stamford, form a fast electric road to compete with the New York & Port Chester road, the building of which is assured.

NEW JERSEY TROLLEY MERGER—It has been announced that $8,000,000 of stock is to be issued in addition to the $10,000,000 that the Fidelity Trust Company of New Jersey is to underwrite as part of the capitalization of the United New Jersey Railways Company, tne new corporation which has absorbed the trolley railway interests in Hudson, Essex, Passaic and Union counties, New Jersey. The certificates for the stock of the four trolley companies and the United Electric Company will represent $20,000,000, while the stock of the gas companies will be as follows: Essex & Hudson, $6,500,000; Hudson company, $10,500,000; Paterson Gas and Electric Company, $5,000,000; South Jersey Electric, Gas and Construction Company, $6,000,000, making a total of $28,000,000 of gas stock and a grand total of $48,000,000 in round numbers. One-sixth of the $48,000,000 represents the $8,000,000 of new stock.

ALASKA'S TELEGRAPH LINE—Within a month the telegraph system of Alaska will be complete, and by fall the cable connecting Seattle with Juneau and the far North will be in operation. These announcements were made at Seattle, Wash., by General Greely, chief of the United States Signal Corps. The cableship Burnside will reach Sitka about June 15 and, after running a cable from Skagway to Haints Mission, will lay the cable southward 1,300 miles in two sections to Seattle. The cable, it is believed, will be in working order November 15. A gap of only fifty miles exists between the eastern and western branches of the Alaska system. The line extends up the Yukon River, from St. Michaels to the mouth of the Tanana, and 200 miles above on that river. The other line is from Valdes, across to Eagle City, near Dawson, a branch of which extends down the Tanana to meet the other. A month, in the opinion of General Greely, will see the two joined.

NICARAGUAN POWER SCHEME—A contract valued at nearly $3,000,000 has been secured by a prominent New York company for machinery to be utilized in connection with an extensive electric railway system which is to be constructed in Nicaragua by the Nicaragua & Transcontinental Railroad. It is proposed to construct some 500 miles of road. The present means of transportation from the coffee plantations of the parties primarily interested in the project and the outside world is by wagon and the distance is about 120 miles. The new railway will shorten the distance to the coast and with its main line and spurs will sweep the major portion of central and northern Nicaragua. The power to operate the new road will be derived from a hydraulic plant, which, it is estimated, will cost some $12,000,000. The railroad company's offices are in Pittsburg. F. M. Latimer, of Pittsburg, is one of the prime movers in the project. C. A. Gaar and J. O. Dye, of the same Pennsylvania city, are also interested.

FOREIGN DEMAND FOR STEEL CASTINGS—Regarding a demand for steel casting in Ireland, United States Consul W. W. Touvelle, stationed at Belfast, writing to the State Department, says: "From recent investigations that I have made, and from numerous enquiries received from different firms in this city, I am satisfied that a good market is open to American manufacturers who can supply steel castings of high permeability for electrical works. Castings of magnetic steel, for field magnets of electric motors and dynamos, and magnetic steel or iron sheet stampings, of high permeability and low hysteresis loss, for armature cores, are mentioned. L. B. Mollan & Company, Alexander street West, Falls road, electrical and mechanical engineers and contractors, and Millin & Company, Ultonia Works, No. 59 Victoria street, are desirous that their names may be brought to the attention of steel manufacturers of the United States, as they are large users of the castings described. For the benefit of possible shippers, I will say that two lines of ocean steamers run direct from the United States to Belfast, Ireland—the Lord Line from Baltimore and Newport News, and the Head Line from New Orleans."

NEW WESTERN POWER SCHEME—The St. Louis Transit Company is arranging to bring its electrical power from across the Mississippi River, and has taken the preliminary steps looking to the erection of a power-house in East St. Louis, close to the coal fields of southern Illinois, where will be generated all the current to move its street cars. According to General Manager Dupont, the capacity of the power-house will not be less than 40,000 horse-power. Work will be commenced on the building early this summer, to the end that it may be completed and in operation before the gates of the World's Fair shall be thrown open. There will be no trouble about bringing the current to St. Louis because of the distance. The power generated there will be carried in cables, either under the water or by the way of the bridge; possibly both ways. At present the company is furnishing electricity for the operation of its county line to Creve Cœur Lake, a distance of twenty miles from the power-house, on Salisbury street, near Broadway. The Transit company's other and larger power-house is at Vandeventer and Vista avenues. Together they have a capacity of 35,000 horse-power. With the addition of the East Side plant, the company will have a capacity during the World's Fair of 75,000 horse-power.

GRADE CROSSING BILL PASSED—The New York Assembly has passed the bill providing for abolishing practically all the grade crossings of steam and third-rail roads in Brooklyn. The bill was drawn by Assistant Corporation Counsel James McKeen and was introduced on April 6 by Assemblyman Morgan. The number of grade crossings affected by the bill is nearly 200 and the estimated cost approximates $8,000,000; one-half of which is to be borne by the city at large, and one-half by the railroad companies interested. The bill provides for the appointment of a commission of five members by the Mayor, one of whom shall be a civil engineer, one to be appointed by the Mayor on the nomination of the Long Island Railroad Company, and one by the Mayor on the nomination of the Brooklyn Rapid Transit Company. The commission shall have complete charge of the improvement and is authorized to employ a superintendent. The bill provides that the tracks of the Bay Ridge & East New York road shall be partly depressed and partly elevated over its entire length. It also provides that the Brighton Beach route may be alternately depressed and elevated from its Fulton street terminus to Brighton Beach and that the Manhattan Beach road shall be allowed to change its route at a point near Sheepshead Bay where it parallels the Brighton Beach route so as to use the tracks of the latter road. The bill limits the expense to the city of the Bay Ridge improvement to $2,500,000 and of the Brighton Beach improvement to $750,000, exclusive of the cost of the removal of water mains and other city property made necessary by the change in grade.

OBITUARY NOTICE.

THE REV. S. MORGAN SMITH, owner of the large water-wheel works in York, Pa., died in Los Angeles, Cal., on Monday, April 13. He was born in North Carolina sixty-five years ago. When a young man he entered the Moravian ministry, and during the war served as chaplain of a volunteer regiment. He retired from the ministry in 1871, and became interested in mechanical inventions, soon establishing the water-wheel works in York. At his death he was interested in many enterprises.

ELECTRIC RAILWAYS.

HIGHMORE, S. DAK.—The Stockmen's Telephone Company has been incorporated at Pierre with a capital of $50,000.

NEW BRUNSWICK, N. J.—The Central New Jersey Telephone Company has been granted a franchise by the common council.

CENTER ADAMS, MICH.—A new telephone company has been organized here, called the Adams Mutual, running to North Adams.

ORRVILLE, OHIO—The Sonnenberg Telephone Company has been organized at Kidron to construct and operate a telephone line.

PARK RAPIDS, MINN.—A new telephone company has been organized at Osage, to be known as the Farmers' Cooperative Company.

PATCHOGUE, L. I.—The New York & New Jersey Telephone Company has been making many improvements to its telephone system in this vicinity.

CHICAGO, ILL.—The Chicago Great Western will construct a private telephone system between its three terminal points—Chicago, St. Paul and Kansas City.

RISING SUN, IND.—The Posey Mutual Telephone Company has been incorporated with a capital of $10,000, and will establish an exchange in Patriot.

MEXICO, MO.—A new telephone company has been organized in the Long Branch vicinity, with William Donaldson as president, and Forest Berry, secretary.

GREENFIELD, IND.—The Shady Grove Telephone Company has been incorporated by J. M. Birch, Joseph F. Shelby, W. H. Foster, W. W. Piles and William Tague.

HAMILTON, N. Y.—The Brookfield Telephone Company has been incorporated by J. I. Keith, B. M. York, H. L. Spooner and A. D. Cheseboro, to construct and operate local telephone lines.

BADGER, WIS.—The West Wisconsin Telephone Company has filed articles of incorporation with headquarters at Glen-Brockly. The company has a capital of $5,000, and was incorporated by D. H. Syme and C. J. Augustin.

EDEN VALLEY, MINN.—C. T. McDonald, M. E. Williams, W. L. Hutcheson, Matthew Weller, William O'Brien, George Tompers and L. E. Christ have incorporated the Eden Valley Telephone Exchange Company, with a capital of $10,000.

MORGANTOWN, W. VA.—A number of the leading business men of this place have made application to the Postal Telegraph-Cable Company for an extension of its lines from Uniontown, Pa., to this place, a distance of twenty-five miles.

RUSHVILLE, IND.—The Orange Mutual Telephone Company has filed articles of incorporation with the auditor of the state, with a capital of $3,000. The incorporators are: W. P. Sipe, W. F. Schrontz, W. R. Conoway, T. F. McKee and George A. Looney.

KEARNEY, NEB.—Articles of incorporation have been filed in the office of the county clerk for the Buffalo County Telephone Company, with a capital of $5,000. The incorporators are: George Bischel, Peter Wink, J. G. Reiter, John D. Lowenstein and W. J. Stadelsm.

TOPEKA, KAN.—The Pioneer Telephone Company, of Guthrie, Okla., has filed a charter with the Secretary of State to operate in Kansas. The capital stock is $500,000, and the stockholders are John M. Noble, of Oklahoma City; John N. Coulter, of Pawnee; J. C. Shepherd, of Pawnee, and Bird McGuire and E. D. Ninis.

ALBANY, N. Y.—The New York & Long Island Telephone Company, capitalized at $100,000, has been incorporated with the following directors: Winifred H. Bennett, George L. Denis, Benjamin P. Talbot, Ivor M. Williams and Herbert Wright, of New York city; Robert Mews, of Long Island City, and A. L. Turner, of New Brighton. The new company proposes to build lines from Long Island City to Greenport, Brooklyn to Long Island City and Riverhead, Brooklyn to Montauk, Flushing to Jamaica and Far Rockaway, Roslyn to Freeport and Rockville Center and Long Beach, Huntington to Babylon, Greenport to Shelter Island, and to Riverhead and Sag Harbor.

ELECTRIC LIGHTING.

SUPERIOR, WIS.—The Marinette Street Car Company will expend $30,000 in an addition to its power-house.

MANSON, IOWA—The electric light plant in this place has been sold to J. Y. Fiddler, of Eagle Grove, for $15,000.

SPRING GROVE, MINN.—An electric light plant will be installed here this summer. Bonds of $5,500 have been voted.

REGINA, CANADA—The Regina city council has voted to install a system of waterworks, electric lighting and drainage.

CHARLESTON, MISS.—Work on the new plant of the Capital Electric Light and Power Company, of Jackson, will begin at once.

SAC CITY, IOWA—The citizens of Guthrie Center have organized a company to install an electric lighting system in the city.

MANCHESTER, N. H.—The board of aldermen has voted to make a five years' contract with the Manchester Traction, Light and Power Company.

SAN ANTONIO, TEX.—The Standard Light and Power Company has been sold by Federal Receiver George P. Meade to Willard Thompkins, of New York, for $46,500.

BERKELEY, CAL.—The board of town trustees has granted a twenty-eight-year franchise to the Bay Counties' Power Company, to maintain its poles and lines in Berkeley.

WINONA, MINN.—The owners of the Winona Railway and Light plant announce their intention to expend $100,000 in the improvement of the plant during the coming season.

IOWA FALLS, IOWA—The Ackley electric light and heating plant, valued at $20,000, has been sold to the Daly Land Company, of St. Paul, and parties from that city will operate the plant in the future.

MEMPHIS, TENN.—The Memphis Consolidated Gas and Electric Light Company, controlled by New York, Chicago and Memphis capitalists, has announced its intention of spending $93,000 in the extension of its conduit system.

SOUTH BEND, IND.—The St. Joseph & Elkhart Power Company, which is building a power dam in the St. Joseph River, has filed a mortgage for $600,000 in favor of the Van Norden Trust Company, of New York.

BOSTON, MASS.—Improvements approximating a half million of dollars are in process at Garvin's Falls, above Manchester, on the Merrimac. The rights are owned by Tucker, Anthony & Company, and they will expend about $400,000 on the work.

YORK, PA.—The substation of the York Haven Electric Power Company, which has been in course of erection in Manchester Township, is about completed, and it is expected that power will be transmitted here from the York Haven plant about September.

MICHIGAN CITY, IND.—The power-house of the Chicago & Indiana Air Line Railway will be located in this city for the operation of the entire seventy miles of trackage from South Bend to Chicago. The power will be transmitted to substations, to be located about ten miles apart.

HAMMONTON, N. J.—The New Jersey Southern Gas and Electric Company, which was recently incorporated, has succeeded in taking over the properties of the Wenonah, Glassboro & Clayton Electric Company; the Electric Light, Heat and Power Company, of Hammonton; the Egg Harbor Electric Light Company; the Swedesboro Gas Company, and a water power sufficient to supply 500 horse-power, and covering 750 acres of land.

PITTSFIELD, MASS.—It is stated that electric power is to be developed on the Farmington River, between the towns of Tolland and Sandsfield, which will furnish power to light cities and towns and run trolleys all over the Berkshires and as far east as Springfield, Mass. New York and Boston capitalists support the venture, on which they are to spend at least $500,000. A large reservoir is to be built in Sandsfield, and the water will be conveyed four miles to Sandsfield Centre, where a power plant of 6,000 horse-power will be located.

ELECTRICAL SECURITIES.

Compared with a week ago, the market condition at the closing of the past week showed a decided improvement in speculative sentiment. The general confidence in securities was also considerably elevated. While there was a sharp decline following the news of the Northern Securities decision and a semi-panicky feeling present for a short time, the rally has been decisive and a more optimistic feeling prevails in financial quarters. The present buoyancy, coming as it does rather late in the spring season, has led some to predict that there will be a continuous improvement until conditions approximate more or less near to the normal spring activity. This argument seems well taken, judging from the long sag which the market has borne, and the self-evident confidence of conservative speculative interests. The statistics of foreign trade for the month of March show that the exports for this period aggregated $131,951,579, or an increase over the same period for last year of $25,202,091. The imports were $90,199,173, or $11,972,091 larger than last year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 18.

New York:	*Closing.*
Brooklyn Rapid Transit	66½
Consolidated Gas	205½
General Electric	190½
Kings County Electric	180
Manhattan Elevated	138
Metropolitan Street Railway	132
New York & New Jersey Telephone	164
Westinghouse Manufacturing Company	202

It is stated that the report of the General Electric Company for the year ending January 31, 1903, soon to be issued, will in all probability show about 22 per cent earned on the $44,000,000 capital stock, after liberal charges to expenses for repairs and construction. Net earnings from all sources, including profits from sales of securities in the treasury, should fall little short of $10,000,000, which would compare with $8,598,241 last year.

Boston:	*Closing.*
American Telephone and Telegraph	158½
Edison Electric Illuminating	275
Massachusetts Electric	88
New England Telephone	135
Western Telephone & Telegraph preferred	96½

Boston had a fairly active market. Massachusetts Electric preferred was ¾ higher, at 88¾, and American Telephone sold up a point to 159, closing at 158½, against 155½ last week.

Philadelphia:	*Closing.*
Electric Company of America	8¾
Electric Storage Battery common	69
Electric Storage Battery preferred	69
Philadelphia Electric	6⅞
Union Traction	46⅞
United Gas Improvement	108

The net earnings for the year of the Electric Company of America indicate a continued gain, and the net returns for January and February are 19 per cent over the same month of last year.

It is announced that the stockholders of the Electric Storage Battery Company have met and approved a proposition to permit holders of preferred stock to convert it into common, share for share. The preferred stock amounts to $4,500,000, all of which will probably be converted.

Chicago:	*Closing.*
Chicago Telephone	150
Chicago Edison Light	155
Metropolitan Elevated preferred	75
National Carbon common	23½
National Carbon preferred	97
Union Traction common	8½
Union Traction preferred	38

Receipts of the Union Traction Company for March are said to have been about $38,000 in excess of receipts for March, 1902.

RECEIVERSHIP NOTE.

RECEIVER FOR CABLE COMPANY—Homer M. Daggett, Jr., of Attleboro, Mass., has been appointed receiver of the Eastern Electric Cable Company, by Judge Colt, in the United States Circuit Court, on application of Henry A. Clark, on behalf of himself and other creditors. In his petition Clark states that the company is insolvent, with a debt of about $100,000. He is the principal individual creditor, claiming about $27,000 and an additional $13,000 on account of endorsements on other obligations.

PERSONAL MENTION.

PROFESSOR L. A. HERDT, lecturer on electrical engineering at the McGill University, Montreal, Quebec, was a visitor in New York last week.

DR. WALTHER NERNST, the well-known German physicist, was a prominent attendant at the American Electrochemical Convention last week. Dr. Nernst spent but a few days in the United States, sailing for Europe last Saturday morning.

MR. HARMON A. HARRIS, of Chicago, of the Automatic Electric Company, the leading advocate of the automatic telephone exchange, spent several days in New York last week. Mr. Harris reports a constantly increasing interest in the use of the automatic system.

MR. ALEXANDER M. GOW was announced to deliver a paper on "Commercial Gases for Power Purposes" before the Engineers' Society of Western Pennsylvania, Pittsburg, Pa., at the regular meeting Tuesday, April 21. The subject of the May meeting will be "Modern Material of Construction."

T. AOYAMA and Y. HATA, of the Japanese Government, Tokio, Japan, have been spending some time in the United States. These gentlemen are interested in telephone construction and in engineering as practised in this country in general, and spent a few days in New York recently looking over some of the engineering interests that the city can afford.

MR. H. L. DOHERTY is chairman of the committee on photometric values of arc lamps, which is busy preparing its report for the twenty-sixth convention of the National Electric Association. This convention, as is well known, will be held at Chicago, May 26, 27 and 28. A report of the tests made at Purdue University, during the past year, under the supervision of Professors Goldsborough and Matthews, will be included, and the report will also show the results of comparative tests of arc, incandescent, Nernst and Welsbach lamps.

LEGAL NOTES.

THE PLACING OF POLE LINES—The placing of telephone poles and wires in a city street is held, in Donovan *vs.* Allert, N. D., 58 L. R. A. 775, to be a new burden of servitude thereon, requiring compensation to be paid to abutting owners. The placing by a private lighting company of poles at the curbs of a street and the stringing thereon of electric light cable lines and wires for the purpose of furnishing light and energy to private takers, is held, in Callen *vs.* Columbia Edison Electric Light Company, O., 58 L. R. A. 782, to be a taking of the property of the abutting owners.

PATENTS SOLD TOO LOW—Mr. Elias E. Ries, through Venable, Baetjer & Howard, attorneys, has filed exceptions in the United States Circuit Court to the ratification of the sale of electric patents, with pending applications and incidental rights of action for infringement, belonging to the late firm of Ries & Henderson. The sale was made on March 3 last by George Whitelock and Arthur Steuart, special masters. The purchaser was Arthur G. Thompson, of New York, who acquired the property for $60,000. Mr. Ries alleged in his exceptions that the price for which the patents was sold was inadequate, and states that new bidders have been secured who are willing to begin bidding for the patents at $120,000. The patents referred to were issued between the years 1886 and 1899, inclusive, to the firm of Ries & Henderson, as assignee of Mr. Elias E. Ries, of 116 Nassau street, New York city, formerly a resident of Baltimore, Md. The property included in the sale embraced forty-seven United States letters-patent. Among the various groups into which these patents are divided are those relating to electric welding and tempering, electric rivetting, electric soldering, electric heating, electric generation and transmission, electric traction, conduits for electric and cable railways, and patents on various electric railway systems. One of the most important of these last-named patents, No. 622,865, of April 11, 1899, was issued to Mr. Ries upon an application filed by him in 1887. This patent contains sixteen claims, which Mr. Ries alleges are of such broad scope as to cover the entire modern electric railway industry. Judge Morris considered the exceptions of Mr. Ries well taken, and refused a ratification of the sale, pending a further hearing which will shortly take place.

INDUSTRIAL ITEMS.

THE FLEMING SLATE COMPANY, Poultney, Vt., has excellent facilities for the production and manufacture of Vermont slate for electrical construction work.

THE THRESHER ELECTRIC COMPANY, Dayton, Ohio, has moved its New York headquarters from 120 Liberty street to the Whitehall Building, 8 Battery place, New York city.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., will be pleased to send to any one interested its catalogue No. 032, descriptive and illustrative of foundry ladle cars.

THE W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., is supplying to the trade a number of celebrated specialties for electrical construction. Prominent among these are the Hill enclosed fuse blocks, Hill switches, splicing sleeves and enclosed fuses.

THE ELECTRIC CONTRACT COMPANY has moved to new quarters, at Nos. 202 and 204 Centre street, New York city. The increased floor space and greater manufacturing facilities will allow the company to keep pace with the increasing demand for its specialties.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, manufacturer of the "Columbia" carbons, will be pleased to send to users sample shipments, subject to return at the company's expense if not as represented. Literature on the subject will be gladly sent to those interested.

THE BRODE ELECTRIC COMPANY, jobber and dealer in electrical supplies, will be pleased to have all communications addressed to 306 South Los Angeles street, Los Angeles, Cal. The company is agent for a line of strong specialties, which are attracting very popular interest on the Pacific coast.

THE CHRISTENSEN ENGINEERING COMPANY, Milwaukee, Wis., manufacturer of air brakes and "Ceco" machinery, has changed the address of its Chicago office to the Old Colony Building, where it will be pleased to receive the communications of its patrons and prospective purchasers of electrical machinery.

THE SHELBY STEEL TUBE COMPANY, Frick Building, Pittsburg, Pa., is sending to some of its friends a handsome souvenir in the shape of a paper knife. This illustrates very readily how the material produced by this company can be manipulated, and is also a testimonial of the finish which can be given to it.

CHARLES E. MILLER, 97 and 101 Reade street, New York city, manufacturer, jobber, exporter and importer of automobile and cycle material, is mailing a new catalogue which gives a very complete list of automobile sundries, including parts, fittings, and a great many European novelties. This catalogue will be mailed to any one interested free of charge.

CHARLES F. JOHNSON, 908 Ellicott Square, Buffalo, N. Y., presents an attractive list of opportunities, both for the sale and purchase of equipments, in his March bulletin. The list includes generators, rotary converters, alternators, arc dynamos, measuring instruments, boilers, locomotives, rails, cars, pumps, and many other useful appurtenances.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., reports that so far this spring it has received more orders for Stombaugh guy anchors than ever before. This popularity is attributed to the ease of installation, the ability to stand great strains, and the general satisfaction which this material ensures. A descriptive pamphlet will be sent upon application.

THE FALLER AUTOMATIC TELEPHONE EXCHANGE COMPANY has leased the new factory building, Nos. 772 and 776 Twelfth avenue, at the foot of Fifty-fifth street, New York city. This is a fine building of six floors, with light all around, and will accommodate about 1,000 hands. The Faller company has taken this building on a ten years' lease, with an option to purchase.

THE STANDARD PAINT COMPANY opened its new factory building at South Bound Brook, N. J., on Wednesday evening, April 22. A number of invitations had been sent out to friends of the company to attend the house warming given to the company's employés. This was attended by a large number of persons prominent in the electrical industry, and a most enjoyable time was indulged in.

THE A. N. KELLOGG NEWSPAPER COMPANY, Tribune Building, New York city, has prepared a handsome souvenir edition, entitled "Eight Points for the General Advertiser." The Kellogg Newspaper Company is the proprietor of the celebrated Kellogg lists. Each point is illustrated by handsome half-tone engravings, and includes "The Article," "The Man," "The Compositor," "The Medium," "The Price," "The Power," "The Files," and "The Returns."

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., has more than doubled the capacity and floor space of its telephone department. This has necessitated, of course, the equipping of the plant with more machinery, and the securing of a number of extra employés. The steady increase in the demand for "Eaco" telephone apparatus has made this step necessary. The company is now distributing literature on its telephone specialties, which it will be pleased to send to any one interested upon request.

THE GARVIN MACHINE COMPANY, Spring and Varick streets, New York city, has on hand a fine line of second-hand machinery and machine tools. The facility which this company has for making exceptional bargains, due to the reorganization and refitting of plants, makes it possible for it to offer to its patrons high-grade machinery which has been slightly used. This apparatus is entirely overhauled and put in first-class condition. Full detailed description of any machine will be sent to any one interested upon request. A recent catalogue issued by the Garvin company describes and lists a number of such machine tools.

MR. LUTHER L. MILLER, Chicago, Ill., attorney and counselor-at-law (patent and trade-mark law exclusively), has recently issued two booklets, one entitled "Trade-Marks, A Book for Advertisers," and the other bearing the simple title of "Trade-Marks." Mr. Miller has made a study of the trade-mark regulations of the United States and foreign countries, and the latter book is a summary of the law of trade-marks of the United States and the principal foreign countries. These books have been prepared for the use of Mr. Miller's clients, and he will be pleased to receive correspondence with regard to securing this valuable literature.

THE LAWRENCE-HALL ELECTRIC COMPANY, 213 West Fourth street, Cincinnati, Ohio, is a dealer in all kinds of electrical supplies. This is a recently organized company, but the facilities for prompt shipment, and the very large stock of material carried, have enabled it to appeal to a very popular trade. The company handles all manner of specialties for electrical equipments, and is the sales agent for "Okonite" and "Manson" tapes, "Okonite" wire, and "Okonite" products. Mr. F. D. Lawrence is president and treasurer of the company, and Mr. William Albert Hall is vice-president and secretary.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., will be pleased to send to any one interested its flier No. 4,025. This describes the "Wood" cutout for arc circuits. This apparatus can be used with any number of lamps up to and including fifty. The copper cutouts are mounted on porcelain, and the iron box is fitted with porcelain bushings. In order to make the installation doubly good, the company has recently slightly modified the design by placing three projecting lugs on the ends of the cutout to receive the porcelain knobs. Instead of being mounted directly on the cross-arm, pole or other support, as heretofore, the case of the box is insulated therefrom by the porcelain knobs.

MESSRS. STONE & WEBSTER, Boston, Mass., manufacturers of electric power traction and lighting plants along Puget Sound, have placed a contract with the General Electric Company for six machines. Two of these will be furnished to the Tacoma Industrial Company for use in its development of the White River, and four to the Pierce County Improvement Company for the work of Puyallup River, including the flow from the Mount Rainier glaciers. The generators will be three-phase, sixty-cycle, 3,500-kilowatt capacity, each supplying current at 2,300 volts and 225 revolutions. Deliveries will commence next September, both of these developments being carried forward and every effort being made to complete them at the earliest possible date to meet the growing demands for power in the Puget Sound district. Power will also be supplied to the electric interurban road between Seattle and Tacoma, as well as the railway and power distributing systems in those cities, which are now controlled by Stone & Webster.